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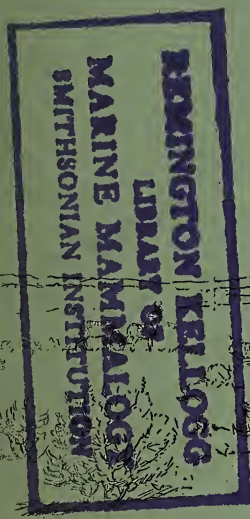
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No. 1

THE FUR TRADE AND THE FUR SUPPLY

By F. G. ASHBROOK

Prior to the world war the international fur trade was handled in Great Britain and Germany. A considerable part of the American furs was shipped abroad and American buyers went to London and Leipzig to procure these furs among others gathered from all parts of the world. At the outbreak of the war importations of furs were reduced to a minimum, and American firms as well as foreign branch houses started dealing in the American product. The effect of the war on the fur trade was, therefore, revolutionary and commercially worked to the advantage of the United States.

Prior to the war, also, auction sales of furs had been held in London, but owing to difficulty in transportation as a result of the war, these sales began to be held in this country. Conditions have actually been reversed, and now not only does the American trade purchase American furs in American markets, but foreign dealers ship considerable portions of their annual collections to the American auction sales, and foreign buyers travel to the United States to purchase their supplies.

The fur auction sales held in St. Louis and New York City are of great importance to the American fur trade. The first St. Louis sale, held in 1915, amounted to considerable less than \$1,000,000, whereas the 1919 winter sale returned \$7,924,330, and the sale held in the winter season of 1921 netted on a declining market \$11,000,000. The first New York sale, in 1916, returned about a quarter of a million dollars, while the winter sale of 1919 totaled \$6,000,000; the winter sale of 1921 on a low market netted \$2,000,000. These figures give an idea of the tremendous offerings at these sales.

FUR TRADE STATISTICS

While statistics are wearisome and are generally taken with mental reservation, yet they serve in helping one form an opinion of the proposition in question. Statistics compiled by the United States Bureau of Foreign and Domestic Commerce show that imports of furs and undressed fur skins during the calendar year 1920 were valued at \$84,427,592 as compared with \$69,289,909 in 1919 and \$32,158,939 in 1918. The value of imports for the calendar year 1920 shows an increase of approximately 22 per cent. Imports of dressed furs and manufactures of all kinds for the calendar year 1920 aggregated \$9,131,348 as compared with \$7,472,336 in 1919 and \$2,491,278 in 1918. The increase for the calendar year 1920 amounted to approximately 22 per cent, or about the same as for the imports of raw furs.

Exports and manufactures of domestic furs for the calendar year 1920 were valued at \$32,886,995 as compared with \$23,788,599 in 1919 and \$11,374,174 in 1918.

The Fur Dressers' and Fur Dyers' Association dressed, during the year 1918, \$35,212,230.28 worth of skins; in 1919, \$51,366,253.14 worth; and in 1920, \$52,910,589.43 worth.

The Board of Trade of the Fur Industry of the United States estimates the annual turn-over in the fur business for the year 1918 at \$232,748,201.86; for 1919, \$342,441,687.60; and for 1920, \$352,605-927.18. It is interesting to note here that the revenue accruing to the Federal Government from articles made of fur during 1920, on which there is a 10 per cent revenue tax, amounted to \$15,311,214.24.

The statistics which have just been enumerated furnish a fair estimate of the volume of the fur industry in the United States. It will be understood, however, that these figures are not immune to criticism; yet they are as correct a representation of the financial phase of the fur industry as it is possible to obtain under existing conditions.

DEVELOPMENT OF THE FUR TRADE

The modern fur trade has developed in the past twenty-five years from a neglected, unimportant industry into one of the largest and most important in existence. The United States has grown to be the largest fur market and fur-consuming country in the world. The fur industry employs many thousands of men and women who make their living from furs and in turn contribute to the comfort of a great number of people.

An industry the finished product of which is so much in demand scarcely needs any further argument for permanent existence. Large industries always have important problems to meet and solve and the fur business is by no means an exception. During the past year the fur trade has been confronted with a number of very important issues. It has been demonstrated that the American fur supply can not be controlled by any single interest, that wild speculation meets with disaster, and that unhealthy competition has no place in the fur business. An all-important question still remaining unanswered concerns the future of the fur supply.

PROBLEMS TO BE SOLVED

If the fur industry is to progress along safe and sane lines, the source of supply should be more definitely assured. This is indeed a very difficult problem, but not impossible of solution; while it is mainly an economic problem, it can not be solved by the trade alone. Neither will the utterances of radical conservationists of wild life assist very greatly in solving the problem. Conservationists of this class generally have a few pet fur bearers in mind and are prejudiced regarding the others. They are satisfied with saying that the future of the fur trade rests entirely with those engaged in the industry. It is foolish to believe that a business of such proportions as the fur industry is not interested in conserving the source of the raw product. A number of raw-fur concerns have been for some time talking conservation and correct legislation for the protection of the fur bearers. Practically all believe that an educational campaign is the only means of bringing results. Some raw-fur dealers have argued the question before their state legislatures only to have their propositions defeated. Others have sent literature to farmers and trappers in various sections of the United States, with a view of educating them to protect and conserve the fur-bearing animals.

The Federal Government, state legislatures, agricultural colleges, and societies interested in the preservation of fur bearers should all lend assistance along practical lines in bringing together the interested parties to solve the problems regarding the source of supply. Intelligent work and cooperation of everyone concerned is necessary to retain permanently all species of fur bearers and not to jeopardize the fur industry.

LEGISLATION

Adequate laws for the protection of fur-bearing animals are indeed very necessary and helpful; but the majority of those now on the statute books do not prevent the decrease of animals in certain sections of our country, neither do they prevent the taking of young animals and unprime pelts, which are practically valueless to the fur trade. Approximately 45 to 55 per cent of the pelts coming to the markets fall into the unprofitable class. Fur of superior quality and more of it would come to the raw fur markets if open seasons were made uniform for states where similar climatic conditions prevail.

Every state should require trappers to take out a trapping license, and in addition every trapper should be bound to turn in to the game warden under oath a report of his catch for the season. The renewal of a permit should be withheld until such report is made. With legitimate trapping under wise laws, the fur supply of our country will not be materially affected.

Areas in which fur bearers have become depleted should be closed completely for a period of years and, so far as may be consistent with the interests of game birds and animals, these regions should be restocked. The national forests furnish excellent breeding grounds where fur bearers can reproduce unmolested, and stock from these breeding grounds could well supply depleted areas. In restocking there is always the possibility that the fur bearers will become pests to the neighboring landowners. This can be overcome, however, if the number of breeding animals is kept constant by proper trapping each season, or oftener if necessary.

There should be cooperation between the Federal and State Governments and the fur trade in framing suitable laws, which are very necessary to place the fur-bearing animals and the fur industry on a sound basis.

NEED FOR EDUCATION

Lack of information on the part of farmers, trappers, and legislators is mainly responsible for inadequate laws pertaining to fur bearers. Many persons do not know that fur-bearing animals are a great asset to a state, and have no idea concerning the annual income derived from pelts produced in their particular state.

Two years ago the raw-fur dealers of the State of New York employed counsel and went to considerable expense to defeat legislation authorizing the hunting of raccoons beginning October 1 instead of November

15. They were unsuccessful and now the hunting of raccoons is authorized in New York to begin on October 1. Raccoon skins taken during October are practically valueless, and a useless waste of fur is the result of trapping under this legislation.

In order to bring about suitable legislation it seems very necessary to launch an educational campaign through state institutions and state societies to cover the entire country. The Biological Survey of the United States Department of Agriculture is in a position to direct such a campaign for the reason that it is deeply interested in the practical conservation of fur bearers and in the future of the fur industry.

If laws such as are herein suggested were passed in the various states, the fur-bearing animals would be conserved on a sane basis. Proper legislation would do more than this—it would for the first time give us an approximate number of the various pelts trapped annually in the different states. The importance of such statistics can not be overestimated. We would then have a firmer foundation on which to base arguments for or against conservation of certain species. The tremendous offerings by the fur auction-sales companies in the United States can not be considered an index of the animals trapped yearly in this country. Muskrat skins to the number of 1,144,016 offered at a single auction make indeed a tremendous figure, but this does not tell the whole story. The chances are that this offering consisted of more than one season's catch. When pelts are received at the raw fur houses they enter into the trade, pass from hand to hand, and undergo a change so complete that their identity is practically lost. It is, therefore, impossible to distinguish with any degree of certainty between muskrats, minks, or foxes originating in the United States and those originating in Canada or any other country.

REARING FUR BEARERS IN CAPTIVITY

The breeding of fur-bearing animals in captivity and the stocking of the national forests and game preserves are enterprises that should be encouraged. The production of foxes, skunks, beavers, and muskrats has proved successful when intelligently managed. The reason this phase of the fur industry has not met with greater success is because there has been too much publicity concerning financial returns and too few warnings to ranchers of pitfalls and obstacles to be overcome.

Inferior animals, temperament, feeding and breeding problems, sanitation, diseases, and parasites all raise questions to be faced by the average stockman and farmer. Every person engaged in the rearing

of fur-bearing animals will meet these same problems sooner or later, and success in the business depends largely on just how completely they are solved. A rancher must further consider that he is handling wild animals in captivity and not domesticated stock in the ordinary sense of the term. It is very true that fur bearers born in captivity are more docile than those from the wild, but they are not in the strict sense of the word fully domesticated.

A knowledge of pelts, pelt values, and market requirements is an additional requisite a fur farmer should possess in order to operate his business intelligently. His harvest is pelts, and he should be well informed as to primeness and quality of fur as well as to market requirements.

A number of raw-fur buyers claim that fur produced on ranches is not popular with the fur trade because it is unprime and lacks the quality and finish of wild fur. This is absolutely untrue, for practically all the silver fox pelts on the market are taken from ranch-bred stock.

The Biological Survey is endeavoring to keep an up-to-date list of persons engaged in rearing fur-bearing animals, in order to be in close touch with the business. It may be interesting to learn that its records show at present 500 breeders engaged in rearing one or more species of fur-bearing animals. The list is as follows: Silver foxes, 265; red and cross foxes, 74; blue foxes, 1; skunks, 81; raccoons, 24; minks, 20; muskrats, 10; opossums, 9; martens, 7; squirrels, 3; beavers, 2; fishers, 2; Russian ermines, 1; and badgers, 1. Although this list for the United States is not complete, it gives a fair idea of what is being accomplished.

The rearing of fur-bearing animals in captivity is practically a new industry, and many people engaged in the business know little if anything about it. The information at hand on this subject is very meager indeed; hence most persons are very shy in answering questions relating to the production of fur-bearing animals. State agricultural colleges and experiment stations and state game commissions and conservation societies should promote the raising of fur-bearing animals in captivity. Extensive investigations along the line of feeding, breeding, and management should be made as well as with regard to diseases and parasites.

CONCLUSION

Too much stress can not be laid on the value of the fur industry in producing a most important article in our domestic as well as in our

foreign trade. Prior to the world war, the world's fur market was in Europe, but since then it has been transferred to the United States.

The largest fur sales in the history of the world are held in St. Louis and New York City. The winter sale held in St. Louis in 1920 totaled \$27,102,588. Ever since the world began, people have worn furs and they will probably continue to do so indefinitely. The fur business, therefore, has good reason for existence.

Information regarding seasons when pelts are prime is necessary for trappers and state legislators in order that the trapping seasons of practically all fur bearers may be properly limited. It is also essential to establish close seasons for certain fur bearers that need this protection. Enforcement of such laws will most certainly prove very effective in conserving the fur-bearing animals, thus establishing the future of the fur trade.

Fur farming is a commendable and hopeful adjunct to the fur industry. Foxes are being raised successfully and the industry has attracted much attention, principally on account of the high prices paid for breeding stock. Skunks, muskrats, and beavers have under certain conditions been raised successfully. Fur farming, therefore, occupies a place in the general scheme of conservation, but the extent to which this industry may become a factor in increasing the production of fur will be determined only by future developments.

Biological Survey, Washington, D. C.

SCATTERED OBSERVATIONS ON NARWHALS

BY DR. MORTEN P. PORSILD

[Plate 1]

A peculiarity of ice conditions in Disko Bay, on the west coast of Greenland, is that the ice instead of first freezing over the bay at the heads of the fiords on the approach of winter and gradually spreading seaward, first forms late in December, when the drifting ice of Baffin Bay approaches the coast. The weather then becomes quiet, with intense cold, and ice rapidly spreads over Disko Bay from the islands near its opening inward toward its head.

"Then it often happens," to quote my article explaining the circumstances in the *Geographical Review* (vol. 6, pp 215-228, September, 1918), "that schools of white narwhals are cut off from the still open parts of Baffin Bay, and are gradually driven in towards the head of Disko Bay. Freezing continues, and finally the schools are restricted to the last smaller or larger open spaces in the ice, whence they cannot escape unless the weather changes and the ice is broken." Their presence there will be betrayed by a column of white vapor of their breath, condensed in the extremely cold air; and the Eskimos flock to the place from far and near to kill and capture the animals, which are valuable to them in many ways. Such a pool of trapped whales is called by the Greenlanders a *savssat* (pronounced s'set), a word used of living animals crowded into a small space. It ordinarily happens, however, that these pools themselves soon freeze over, and then the imprisoned animals are compelled to break breathing-holes through the ice, and keep them open, in order to get air. It has been my fortune to see several of these *savssats*, and to witness the slaughter and capture of the whales; and it is from such experiences that I have derived the information given below as to some features of narwhal life and anatomy.

So far as I know, it has not been previously recorded that various species of arctic whales are able intentionally to break holes through the ice for breathing. At the first *savssat* I visited the holes in the morning were from a few to several feet long and from one to three feet broad; by lengthening and merging into each other, the first holes broken developed to cracks. The holes are broken by blows with the thick and firm cushion on the upper side of the head, in front of the so-called "blowing-hole," or exit of the nostrils. The Eskimos at

Godhavn and Skansen, well acquainted with the habits of the narwhal in ice, declare positively that the male carefully guards his tusks from bumping into firm and tough ice. Once Ludvig Geisler, from Skansen, found a single large male sleeping near a lead in very hummocky ice, its mighty tusk projecting out over the surface of the ice and leaning against it. The animal awoke before Geisler could get his rifle clear and very slowly and cautiously drew back the tusk until it was quite clear, when it rapidly dived away.

In the drawing of G. Kleist (cf. Porsild, l.c., 1918, p. 221) illustrating the most ordinary form of *savssats*, may be seen a number of male narwhals emerging from a very small hole with their tusks resting on the surface of the ice. Here natural openings in the ice are gradually diminished by freezing, and the stronger males push away the weaker ones and the females. Eventually the animals become so worn out that they stay at the hole constantly, resting their tusks on the ice, and do not quit it again.

Whales of other species are also able to break breathing holes in ice. It is as common with white whales (*Delphinapterus leucas*) as with narwhals; some natives state that the holes broken by the white whales are a little trapeziform in shape and thus distinguished from those of the narwhals, but others deny this. Giesecke mentions in his diary a case where a harpooned northern right whale ran with the line under the ice and broke ice that was more than a foot thick. Numerous cases of a similar kind are related by him from the hunting of that species at Godhavn in olden time. The humpback whale (*Megaptera boöps*) has ordinarily left the waters of Disko Bay when the ice covering sets in, but sometimes it happens that a single straggler is delayed by the lure of unusually large schools of the polar cod (*Gadus saida*), and thus is surprised by the ice covering. It then breaks open large triangular or trapeziform holes. Some years ago a young specimen had made a trial in very hummocky ice intermingled with calf-ice from collapsed icebergs near my dwelling. It probably had become stupefied by the blow and had died by drowning or from wounds in the head. It was found dead and frozen in the ice by a dog.

It was not possible to ascertain even approximately the ratio between the males and the females, young and full-grown individuals, of the narwhals. Full-grown males with big tusks were most eagerly pursued as long as the animals were numerous. I do not doubt that the number of females by far exceeds that of the males. The ventral side of both sexes was considerably lighter colored than the back, but

the females were as a rule much lighter colored than the males, and in them the light color extended from the whole ventral side up over the flanks.

On several females I noticed wounds two to four inches long near the genital openings. They were narrow, resembling incisions made by a knife, and ran lengthwise of the body. All the wounds that I saw were infested with apparently the same parasite that always infests the fold of the skin about the root of the tusk (*Cyamus nodosus* Lütken). In his monograph of the species of *Cyamus* (Kgl. Vidensk. Selsk. Skr. 5 R. naturv. and math., Afd. 10. Kjöbenhavn, 1873) C. F. Lütken states that he does not yet know whether this parasite occurs only on the male narwhals or not.

Several, but not all the full-grown females were with young. The stage of development of the foetus of the gravid ones varied greatly, the foetuses ranging from very small to nearly full-grown. This corroborates previously expressed opinions that a definite rutting season does not exist amongst narwhals.

As is well known, two tusks grow in the upper jaw of both sexes of the narwhals, but as a rule the left one of the male protrudes and develops into the large tusk. Both tusks of the female, and as a rule the right one of the male, remain included in the tissues; but in rare cases both tusks are developed in the males, the right one then often somewhat shorter and weaker than the left one. A specimen with two tusks was seen several times during one of the *savssats*, but unfortunately was not secured.

The undeveloped tusks often show a characteristic appearance, for they are in the process of absorption, especially in old individuals. The surface is then "louse-eaten," say the Greenlanders, who also pretend to be able to distinguish the incipient tusks of the females from the right one of the males, the latter being straight, they say, whereas the former are slightly curved. The small tusks soon become solid. Those of the young individuals are very strong, and are used by the Eskimos as part of their towing implements.

The root end of the developed tusk in young individuals is very thin-walled, but in old specimens this cavity is gradually filled up with very fine bone. The bone of the root end of very old tusks is technically the best of the whole tusk, being not liable to splitting and warping as the other parts often are. However, there is always a thin canal left, leading up to the large cavity running through the whole length of the tusk. When uninjured this cavity is filled with a spongy core, rich in blood.

The distal part of every protruding tusk, as well in the young as in the full-grown individuals, is white and polished. In the rare cases of two developed tusks, sometimes the right one is shorter, but its distal part is polished to the same distance from the point as the other. From the polished point towards the base, the spiral furrows always show a dense red-brown or greenish algal growth, heretofore not mentioned. According to an investigation kindly made by Prof. L. Kelderup Ros-eavinge at Copenhagen, this alga is a sterile species of *Rhodochorton* probably *Rh. rothii* very common along the shores of Greenland. Several diatoms not determined were also found by me.

The tusks of a large number of old males are broken at various distances from the point. Of 314 specimens seen at one time by the late Prof. H. Jungersen, 107 were broken. The cavity is opened by the breaking, and the blood-filled content gradually oozes away. The broken end with its spirals becomes worn, the algal growth on the outer surface disappears, and the sharp edges of the fracture are smoothed and polished; often the algæ also develop a short distance into the cavity. The strangest feature is, however, that not seldom *a point of another smaller tusk is found thrust into the cavity and then broken off*, a real "tooth-filling." The occurrence of this strange phenomenon is well known to the Eskimos of Greenland, who tell wonderful tales about it. They say an old male with a broken tusk entices a younger one to thrust its tusk into the cavity, whereupon by a jerk, it breaks the tusk of the younger narwhal. Robert Brown (Proc. Zool. Soc., London, 1868, p. 90) says; "They seem to fight with them; for it is rarely that an unbroken one is got, and occasionally one may be found with the point of another jammed into the broken place, where the tusk is young enough to be hollow or is broken near enough to the skull."

Of "filled" specimens I have seen four, two at Godhavn, the best of which is here figured (plate 1). Another pair was kindly shown to me by Mr. J. Krogh, chief factor of the colony of Jakobshavn. All specimens were sent to the Zoological Museum at Copenhagen. Among the specimens seen by Professor Jungersen one was remarkable, as the filling was broken in the cavity of the larger tusk, *not reaching its outer end*. Thus it could not be pulled out, but only taken out after sawing.

A fight between narwhals has never been observed by the Eskimos of my acquaintance. They declare the narwhals to be peaceful and well-behaved animals. If fighting amongst males regularly takes place, one might expect to find their heads scarred and wounded, but neither I nor my Eskimo informers ever saw this. In one of the cases I have

seen, the filling was jammed so solidly that it could be pulled out only with a pair of tongs, and under the filling was found a wing-feather of a guillemot. I must confess that I am at a loss to understand how that curious filling is effected. The fact seems to have been observed at a very early date. The learned Danish historian of the seventeenth century, Olaus Wormius, wrote several papers about the true nature of what was then styled "Unicornu." I owe this information to the late Prof. H. Jungersen of Copenhagen, who had promised to renew the histological and zoological investigation of the "filling." Since he was prevented in so doing by his premature death, I feel free here to quote part of his letter, hoping that some other zoologist will take up the question. I do not have access here in Greenland to the works of the elder authors mentioned hereafter, and thus can not prosecute the investigation of the older literature myself.

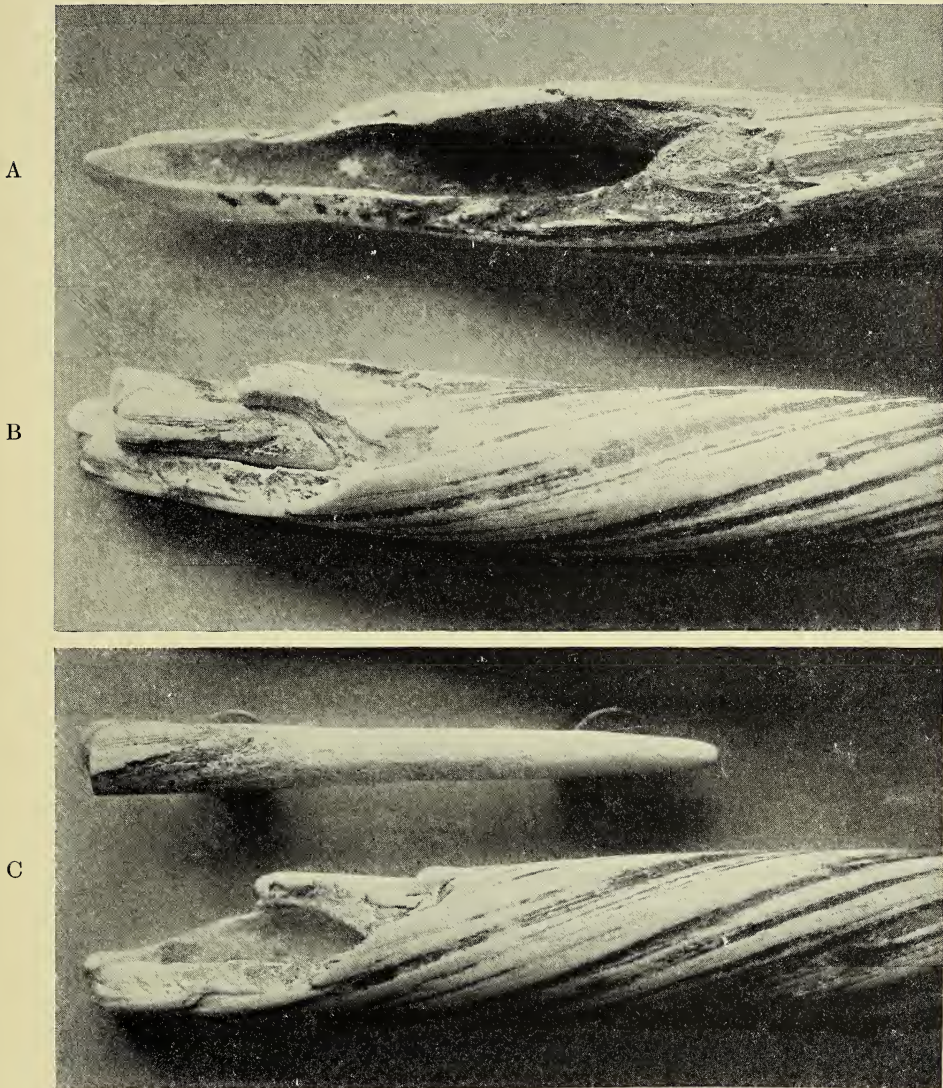
Professor Jungersen writes:

I have not yet succeeded in finding the *ipsissima verba* of Wormius; I am acquainted only with the resumé given by the Dutch author, Claas Mulder, 1835, of La Peyrère's account of 1678. In translation it reads as follows: "La Peyrère narrates that he heard from the Chancellor of the Kingdom of Denmark that the king of this country wished to present as a gift to some one a fine specimen of a Unicornu, and therefore had an entire horn sawed through at its thickest end. It was supposed to be quite solid, but it was found to be hollow. To the greatest surprise of all, a small horn of the same shape and quality as the big one was seen in the cavity. Further, the sawer cut the big horn through across without damaging the small one, and it was noticed that the small one was concealed in the big one as far as the cavity extended. . . . I think it is the same case mentioned by Wormius. He mentions the Royal Apothecary, Elias Fleischer, who sawed the tusk for him, and who by vigorously shaking and pushing succeeded in getting the small tusk out. Wormius adds that he never before observed a case like this, although he had seen many narwhals' tusks."

As far as I can see, Mulder has however never seen the writings of Wormius. La Peyrère owes his knowledge to Wormius, either from his writings or his correspondence.¹ I have hitherto not been able to find the quotation myself; all our old literature being at this moment in the hands of Dr. Garboe, who at present is studying all the tales of the olden time about the "Unicornu."

If La Peyrère relates rightly, that "small horn" is however very enigmatic, reaching down to the very base of the large tusk. Old Peter Camper has, on

¹ Or from verbal information. La Peyrère visited Copenhagen, 1644-45, in the suite of the French ambassador. He became a friend of Wormius, studied in his famous "Museum" and got from him most of the materials for his books: *Relation de Groenlande* and *Relation d'Islande*. Cfr. C. C. A. Gosch: Udsigt over Danmarks zoologiske Literatur, 2. Afd., I, Bd., P. 29.—M. P. P.



BROKEN AND FILLED NARWHAL TUSKS

A.—A large broken tusk, not “filled.” The bloody contents of the cavity have disappeared; the algal growth has developed over parts of the fracture and into the cavity; the point is worn and white, its edges smoothed. B.—A strong tusk broken and afterwards “filled.” The sharp edges of the fractures worn and smoothed. C.—The same specimen with the “filling” pulled out.

the basis of this account, invented the story about a shedding of the teeth. Nowadays it is well known that neither the narwhal nor any other Cetacean sheds the teeth.

Danish Arctic Station, Disko, Greenland.

NOTES ON NEW HAMPSHIRE MAMMALS

BY C. F. JACKSON

During the past few years an attempt has been made to collect complete data concerning the distribution and relative abundance of the vertebrates of New Hampshire. In making this survey some very interesting mammals have been discovered which were thought to have been driven out of the state or exterminated long ago.

Perhaps the most interesting discovery is that of a pair of cougars whose range extends along the east side of the Androscoggin River in the town of Cambridge to the southern shores of Lake Umbagog. Records of the occurrence of this species in recent years are very meager. For the southern part of the state below the White Mountains, the latest record I can find is that of a large male which was shot near Epping, New Hampshire, in 1870. In 1885 a specimen was taken in the White Mountains which is the latest record I have for the state. Rumors have been heard from time to time of the cougar occurring in Maine and in the Green Mountains of Vermont.

Dr. E. W. Nelson of the Biological Survey has referred me to two records, one from Vermont and one from Maine. The latest Vermont record is furnished by Merriam in the Proceedings of the Washington Academy of Sciences (volume III, 1901, page 582). According to this record the last one killed was in 1894. In the same letter Doctor Nelson referred me to The American Field (volume 66, page 400); which cites the killing of a panther in Maine near Mount Kineo in 1906.

It would seem that the species has been able to survive in the less frequented portions of Maine.

It is not known whether the two panthers referred to above are male and female, although this is probably the case. One was seen at very close range by Mr. H. T. Woodward of Berlin and was thought by him to be a male.

A second unusual species is the wolverine, a pair of which were found in 1918 in the Diamond region east of the Connecticut Lakes. Two young animals were taken, which would lead one to believe that the species was breeding to a certain extent within this wild region.

The beavers, which have always persisted, are now represented by two rather prosperous colonies in the Diamond region. In addition to these the work of isolated individuals is occasionally found on both the Dead and the Swift Diamond and their tributaries.

The otter is also found, particularly in the northern parts of the state, although the species is rapidly being exterminated.

At present the authentic record of New Hampshire mammals occurring within the state during the past five years, includes all the large species known to have occurred formerly with the exception of the timber wolf, the northern gray fox and the woodland caribou.

The last record in my possession of the timber wolf is that of a specimen taken in the White Mountains in 1887. In regard to the northern gray fox, the only record which I have is that of the type specimen described by Merriam in 1903, which was taken at Marlboro, New Hampshire. Tracks of a small herd of four woodland caribou have been reported from near the Canadian line in the Connecticut Lake region by an old trapper. This report, however, has not been confirmed. While a specimen was obtained in Houlton, Maine, in 1893 and tracks seen as late as 1896 (Recreation, volume IV, 1896, page 140) no caribou are known to have occurred within this state for a number of years.

The following is a preliminary checklist of the mammals known to have occurred within the state during the five year period from 1915 to 1920. The list is exclusive of the families Muridæ and Zapodidæ, and the orders Insectivora and Chiroptera. Sufficient collecting has not as yet been done to make even a preliminary report on these groups.

1. *Phocæna phocæna* (Linn). Common Harbor Porpoise.—Comparatively abundant off Portsmouth Harbor.

2. *Odocoileus virginianus borealis* (Miller). Northern Virginia Deer.—Common throughout the state.

3. *Alces americanus* Jardine. Moose.—Found only rarely in the northern part of Coos County.

4. *Sciurus hudsonicus* (Erxleben). Northern Red Squirrel.—Very common in the northern part of the state.

5. *Sciurus hudsonicus loquax* Bangs. Southern Red Squirrel.—Common throughout southern part of the state.

6. *Sciurus carolinensis leucotis* (Gapper). Northern Gray Squirrel.—Common throughout southern two-thirds of the state.

7. *Tamias striatus lysteri* (Richardson). Chipmunk.—Locally common throughout the state.

8. *Marmota monax preblorum* Howell. Woodchuck.—Very common throughout the cultivated regions.

9. *Glaucomys sabrinus macrotis* (Mearns). Canadian Flying Squirrel.—Found locally in the northern part of the state.

10. *Glaucomys volans* (Linn.). Southern Flying Squirrel.—Found occasionally in the southern part of the state.

11. *Castor canadensis* Kuhl. Beaver.—Two colonies in the northern part of Coos County.

12. *Erethizon dorsatum* (Linn.). Porcupine.—Fairly common throughout the northern two-thirds of the state.

13. *Lepus americanus virginianus* (Harlan). Varying Hare.—Very common locally throughout the state in mountainous parts; abundant near tree line.

14. *Sylvilagus transitionalis* (Bangs). Northern Coney Rabbit.—Abundant south of White Mountains.

15. *Phoca vitulina* Linn. Harbor Seal.—Usually three or four are found during the winter in Great Bay.

16. *Felis cougar* Kerr. Cougar.—Two individuals as noted above.

17. *Lynx canadensis* Kerr. Canada Lynx.—Occasionally found from White Mountains northward.

18. *Lynx rufa* (Schr.). Bobcat.—Fairly common throughout the wooded parts of the state.

19. *Vulpes fulva* (Desm.). Red Fox.—Common throughout state.

20. *Lutra canadensis* (Schr.). Otter.—Very rarely found. In the northern part of the state.

21. *Mephitis nigra* (Peale and Beauv.). Eastern Skunk.—Locally abundant.

22. *Gulo luscus* (Linn.). Wolverine.—As noted above.

23. *Mustela vison* Schr. Mink.—Occasionally found throughout the state.

24. *Mustela cicognanii* Bon. Little Brown Weasel.—Quite common throughout the state.

25. *Mustela noveboracensis* (Emmons). Large Brown Weasel.—Fairly common in the southern part of the state.

26. *Martes americana* (Turt.). Pine Marten.—Found occasionally in the northern part of the state.

27. *Martes pennanti* (Erx.). Fisher.—Found rarely in the northern part of the state.

28. *Procyon lotor* (Linn.). Raccoon.—Occasionally found in the southern two-thirds of the state.

29. *Ursus americanus* Pallas. Black Bear.—Rather common in the White Mountain region and the northern part of the state.

New Hampshire College, Durham, N. H.

CONCERNING LICE

BY G. F. FERRIS

Probably every collector of mammals has occasionally noticed the lice that usually come out to the ends of the hairs of a mammal within a few hours after it has been killed. But that very few mammal collectors have ever taken any particular interest in these parasites is sufficiently attested by the infrequency with which they are received by entomologists and the paucity of information concerning them. And, indeed, why should mammalogists take the time to collect a group of insects that have had little enough attraction even for entomologists and that are usually spoken of in our entomological texts merely as "disgusting parasites," illustrated by one or two crude figures and grudgingly accorded a page or two of passing mention?

Yet these parasites are really of sufficient interest to merit something more than this scanty consideration. Rather than the apology for studying them, which prefaces a certain old book, there should be an apology for not studying them more. Aside from the importance accorded to the notorious "cooty" because of its disease-transmitting proclivities there are other factors that may justly entitle them to some share of our attention. The special interest of the lice in general lies in the fact that they may be made to contribute some small addition to the mass of evidence upon which our theories of evolution are based.

No one can study these insects for any length of time without being struck by certain peculiarities in the distribution of the various groups and even of the various species. Here are a few of these peculiarities, chosen more or less at random. What is the explanation of them?

The various species of *Microtus* and related genera, both in Europe and North America, have upon them the same species of louse. There are upon the various species of *Citellus* and related genera in western North America two species of lice that are apparently identical with two species which occur upon at least some of the Siberian species of *Citellus*. There is upon the llama in South America a very peculiar louse that appears to be identical with one which was originally described from the camel. There occurs upon the California sea lion a louse that is found also upon another Otariid in the Antarctic region, although these two mammal species are separated by at least the width of the tropics. There is upon the harbor seal of the California coast a louse that occurs also upon the various species of *Phoca* in the Atlan-

tic, although these seals have not had the advantage of any modern Panama Canal.

Another aspect of the same phenomenon appears when we consider the distribution of related species of lice. The nearest relative of the louse of the domestic pig is found upon the wart hogs and bush pigs of Africa. The Sciuridæ may boast of the possession of three genera of lice of which two are known only from squirrels, upon which they may be found wherever squirrels are found. The other genus is found also upon the Muridæ. The lice of the monkeys find their nearest relatives in the lice of man.

It is in fact a general rule—to which there are by all means exceptions—that a single species of louse will be found only on closely related hosts and that related species of lice will be found on related hosts.

I have said that there are exceptions to this rule, and some of them are glaring enough. One such exception is the occurrence upon *Sorex araneus* (the only Soricid that is known to possess lice) of a species that is identical with or at least very closely related to a species that occurs also on the domestic rat. Another is the occurrence upon the domestic dog and also upon foxes of a species the nearest relative of which is another species found upon the domestic sheep. And what are we to say of the louse which appears to be normal to kangaroos but which has once been taken from a dog in Africa, twice from dogs in, and once from a coyote near, San Francisco and once from a man in the Federated Malay States?

Aside, however, from these and some other disturbing exceptions the facts are fairly harmonious and their broader implications are fairly evident. It would seem that the normal occurrence of a common parasite species upon two or more geographically separated but genetically related host species may adequately be accounted for only by the assumption that the common ancestor of these hosts had upon it this same parasite species. In a manner of speaking the occurrence of the parasite upon these different host species is a part of their racial inheritance. It requires only an extension of this theory to account as well for the occurrence of related parasites upon related hosts. In fact it appears that in general the problem of the geographical distribution of the parasite species is to a very considerable degree bound up with the problem of the relationships of their hosts.

Now if we attempt to push this theory to its apparently logical conclusion we shall be led to the assumption that the original ancestor of all the mammals had upon it the original ancestor of all the lice. I

hasten to abjure any thought of such a conclusion for there are a considerable number of factors which need not be considered here but which will doubtless operate effectually to negative the apparent logic of the situation. In fact it would be a most extraordinary thing if even the roughest approximation to such a conclusion could be obtained. But how far can the theory reasonably be pushed? At what point will we be compelled to witness that "saddest of all spectacles, a beautiful theory slain by a fact?"

The only way to answer such questions is by the examination of a complete collection of the parasites of all the mammals, and the obtaining of such a collection is no easy matter. An approximation to a complete collection from the smaller mammals may eventually be obtained by the examination of the skins in the collections of our museums. The present writer, through the kindness of the authorities of the National Museum and the Field Columbian Museum, has been permitted to examine the collections in these two museums with most gratifying results. Just how gratifying the results were may be judged from the fact that when the work on the material thus gathered is complete our knowledge of these parasites will be more than doubled. But the parasites of the larger mammals can not be procured in this manner for the tanning and cleaning of the skins leaves at the most nothing but an occasional egg glued to a hair to tantalize the enthusiastic louse collector with visions of what previously must have been there.

It seems that the only way to obtain material from the larger mammals is through the interest of those by whom they are killed and it is with the hope of arousing this interest that this note is written. How scanty our information concerning the parasites of the larger mammals is may be judged by the fact that of North American mammals alone we do not know any of the lice of the caribou, elk, moose, bison, musk ox, bears, wolves, wolverine, otter, fisher or any of the cats other than the wild cat. In other words our ignorance of the lice of the larger mammals is almost complete.

The rapid disappearance of these larger species makes it imperative that anything that is to be done shall be done soon and this is an appeal to those who may have an opportunity to examine any of these larger species to do so. But little care is necessary in preserving material, dried specimens being as valuable as any others. A few lice entangled in a mat of hair and dropped into an envelope may serve to fill up the gaps in our knowledge and reduce the list of host names in the "unknown" column.

Stanford University, California.

SURFACE WANDERINGS OF FOSSORIAL MAMMALS

BY A. BRAZIER HOWELL

The writer had always thought it an accepted theory that certain fossorial mammals move about on the surface of the ground to some extent, but recent enquiry among mammalogists has brought to light considerable skepticism on this point. Published proof is meager, and the most conclusive evidence that has yet appeared seems to be that presented by Dr. H. B. Bryant (Univ. Calif. Pub. Zool., XII, 2, 1913, pp. 25-29), who found a number of gophers that had been caught in a gutter full of tar. It may be argued that these animals were forcibly driven from their burrows by a flood of irrigation water; but, under the circumstance, it is more likely that the advance of the dry season had rendered the soil in which they were working too hard for their taste, and that they were seeking new pastures.

For ten years I lived on my orange grove at Covina, Los Angeles County, California, where gophers (*Thomomys bottæ pallescens* not typical) were so common that I have taken 300 on ten acres within six months. During the greater part of the year the ground was scrupulously and finely cultivated, and not a weed allowed to grow; hence, gopher mounds were readily found as soon as formed. One of our chief cares was to find every one of these animals that entered the grove from the surrounding territory and catch it at once. As there were no other growing things, each gopher invariably made for an orange tree to feed on the tender bark of the roots, and if he happened to strike and girdle the tap root, sixty dollars worth of damage was done. So one may well believe that we exercised the utmost vigilance to keep the grove free from these pests, and except during the winter, when a leguminous cover crop was grown, mighty few gophers remained undetected upon the ranch for more than twenty four hours. For this reason, it was impossible for a gopher to work its way, underground, into the center of the grove before it was discovered. They habitually entered from a piece of uncultivated land on the south; from a pasture on the east, for the most part unirrigated; and from the weedy borders of a highway on the west. Of course, the usual mode of entry to the property was by short extensions of the burrows until the boundary was crossed, but in at least two score instances, their workings suddenly appeared from a few yards to as much as 380 feet from the nearest cover. And at that, they traveled over bare ground, where, one would imagine, there would be slight attraction to lead them on. Six or eight

times we have, when attending at night to some such activity as fumigation, encountered lone animals meandering about through the trees and far from any possible burrow. Nor have I taken into account those animals found on the move during the monthly irrigation, for then they are flooded out and will make for the nearest dry ground.

On my ranch near Calexico, Imperial County, California, the pale *Thomomys perpallidus albatu*s is abundant, but in this locality the gophers live only in the banks of the larger irrigation ditches, where they are at all times out of reach of flooding. They never enter the fields for more than a few feet, for in summer these are thoroughly irrigated at least every ten days and sometimes oftener. My foreman is occupied with irrigating a great deal during the night, and he informs me that he often finds gophers wandering about well away from burrows, and in situations that would preclude the possibility that they had been flooded out.

The habit of *albatu*s in apparently instinctively shunning ground that will shortly be flooded is worth noting in comparison with that of the Covina animal, which latter will readily seek the lowest spots, from which they are regularly driven by water. Under original conditions, *pallescens* was never troubled by too much water, except in very rare conditions, as when a cloudburst would drive a few unlucky animals onto higher ground. On the other hand, *albatu*s was originally confined to the bottom lands along the lower Colorado River. At stages of low water the most attractive habitat was undoubtedly the lower association close to the river, as the herbage there would be of a more luxuriant character. However, such animals as obeyed this urge would invariably be flooded out and drowned by the annual high water conditions. Hence, along the river, they seem to be, or rather, they were, a number of years ago, found only in those situations that are seldom or never subject to such perils. In the recent extension of range of these animals into the Imperial Valley, their movements are apparently actuated by the same caution in regard to water. Call it instinct or what you will.

It is well known that pocket gophers will make excursions of several feet from their burrows, even in the daytime, after especially attractive food, but they usually prefer to burrow under their larder, and will thus hollow out a large squash or pumpkin from beneath, leaving no external signs of the depredation. Very young animals are sometimes observed sunning themselves near the entrances to the tunnels in the most unconcerned manner, but such actions are probably due more to curiosity than to anything else.

It seems to be the accepted theory that most of the surface traveling indulged in by gophers is undertaken by old males in search of mates. However, while the males will undoubtedly seek out the females, either below or above ground, by far the majority of proven cases of emigration of which I know have consisted either of females or of half grown animals. The old males, being larger (in many forms) and better fitted to cope with adverse conditions, such as hard digging through the drying soil for a failing supply of food, are probably more prone to remain in one spot than are the smaller, weaker individuals. At any rate, but few pocket gophers elect to live in bone-dry ground. It is true that they often make short excursions into it, but in almost all cases the main runways are in soil with some indications of sub-surface moisture. During the old days before the advent of the white man into the ranges of many of the lowland gophers in California, conditions entirely propitious for the presence of these animals occurred in somewhat restricted, and often scattered, areas, as small stretches of grass along the upper washes, or around the border of a cienaga. These spots were frequently separated from each other, sometimes by considerable distances, and at other times by little rocky ridges only a few yards across. If the animals traveled only underground, they then would frequently be confined to the immediate vicinity of their birthplaces, and inbreeding would soon occur, with consequent deterioration of stock and even extermination in small areas, which could not subsequently be restocked. Hence, the ability and incentive for overland traveling is of considerable importance to many members of the genus.

Very few pocket gophers have been taken in surface traps, probably for the reason that the ordinary mouse trap is too weak to hold such an animal. The present writer uses a home-made, wooden-base trap of the usual pattern, but the spring has almost twice the pull of the ordinary, factory-made product, and the part that secures the animal measures two and a quarter inches each way. These obtain greater results, for I have taken three small gophers in them, baited with oats, and with no burrows nearby. Even this trap is, of course, entirely inadequate for large or medium-sized animals.

The same contention obtains for moles: the ordinary mouse trap is out of the question, and even my larger ones can hold the smallest animals only when the trap can kill them instantly by smashing the skull. After the following manner I have caught three individuals of the coast mole (*Scapanus orarius orarius*) in oat-baited traps.

A specimen June 23, 1919, near Hardy, Mendocino County, California, in a trap set beneath a log, which latter was several inches above the ground for a distance of three feet. There was no sign of an open burrow within eighteen inches of the trap in either direction.

A specimen September 9, 1920, at Pleasant Valley, near Tillamook, Oregon, in a trap set at the edge of a blackberry thicket. Consequently, the ground could be examined for only a foot or more from the trap, but no burrow was found.

A specimen September 17, 1920, at Netarts, Tillamook County, Oregon, in a trap set in a dense thicket of salal (*Gaultheria shallon*) on a hillside. There was much trash on the ground, which I carefully removed for three feet in all directions, but could find no burrow.

As mentioned, these three animals were killed instantly by deep fractures of the skull. One can but speculate on the number of moles which blundered into the traps and, because of not being paralyzed at once, easily pulled free.

Pasadena, California.

CHLAMYTHERIUM SEPTENTRIONALIS, A FOSSIL EDENTATE NEW TO THE FAUNA OF TEXAS

BY ALVIN R. CAHN

[Plates 2-3]

The discovery by Leidy¹ of the large edentate *Chlamytherium septentrionalis* in Cenozoic deposits of Florida was, so far as the writer knows, the first find of this South American genus in the United States. Leidy described this animal under the name of *Glyptodon septentrionalis* sp. nov., from a number of dermal scutes. These, together with other scutes, were subsequently referred to *Chlamytherium humboldtii*, a South American species of the genus. Sellards² found more scutes and a right lower jaw in Pleistocene deposits of Florida, which showed that the North American animal was of a species distinct from the South American. Sellards, therefore, revives Leidy's specific name, but retains the generic name of *Chlamytherium*. Previous to the discovery of this jaw by Sellards, the only known remains of the animal in North America were a number of dermal scutes, and a portion of the movable

¹ Leidy, Proc. Acad. Nat. Sci., Phila., 1889, p. 97.

² Sellards, E. H., *Chlamytherium septentrionalis*, an Edentate from the Pleistocene of Florida. Am. Journ. Sci., Vol. XL, 1915, pp. 139-145.



CHLAMYTHERIUM SEPTENTRIONALIS

Upper fig.—Outer surface of jaw. Lower fig.—Inner surface of jaw. (Reduced.)



Fig. 1.—Dermal scute, outer surface.



Fig. 2.—Dermal scute, inner surface.



Fig. 3—Horizontal ramus of right jaw viewed from above. (Reduced.)

CHLAMYTHERIUM SEPTENTRIONALIS

band, all from Florida. A specimen from Texas, therefore, is of great interest, and extends the known range of this rare edentate considerably both to the north and west.

On March 6, 1921, the writer and two students visited the Brazos River at Pitts Bridge, about eight miles south and west of Bryan, Brazos County, Texas. At a point about a quarter of a mile below the bridge, on the Brazos County side of the river, one of the students, Mr. W. A. Rounds, found a right lower jaw of *Chlamytherium*, probably *septentrionalis*. For this identification the writer is indebted to Dr. W. D. Matthew and Dr. O. P. Hay. At the same time, but at a distance of over a quarter of a mile from the jaw, a single dermal scute was found, which may or may not belong to the same individual. A couple of months previous another scute, together with a piece of rib, had been found by Dr. Mark Francis, in the same place as was the scute found by the writer. This rib and scute were identified by Doctor Hay as belonging to *C. septentrionalis* several weeks before the discovery of the jaw.

The jaw has been very kindly donated by Mr. Rounds to the museum of the Texas Agricultural and Mechanical College, where it and the other specimens have been permanently placed.

It is somewhat uncertain from which formation this Texas jaw came. The Brazos River in this vicinity has cut a wide Eocene valley, which is largely filled with Quaternary and Pleistocene deposits, and these form abrupt, cliff-like banks to the stream. The jaw was found in a partially buried condition in a pile of sand which had recently slid off the face of the nearly perpendicular wall of the river bed, and was lodged at the top of the talus slope. It is evident that the dislodgment was recent, since a broken piece of the horizontal ramus was found close by in the sand. The deposit was presumably Pleistocene, but this can not at present be definitely stated. In addition to *Chlamytherium*, the following forms have been found in the vicinity of Pitts Bridge: *Equus complicatus*, *Elephas columbi*, *Elephas imperator*, *Mastodon americanum*, *Gomphotherium gratum*, *Camelops huerfanensis*, *Bison* sp?, *Megatherium* sp?, *Testudo crassiscutata*, etc.

The jaw under discussion, in spite of the fact that it has but two teeth in place, is in a considerably better state of preservation than the Florida specimen. Eight dental fossæ are complete; half of the ninth (the first incisor) fills the entire dental quota of one-half of the lower jaw. The ninth (molariform) tooth is present as a broken fragment, as in the Florida jaw; the seventh tooth is firmly in position and is complete.

With the exception of the missing teeth, two insignificant chips from the posterior margin, and the anterior margin of the mandibular symphysis, the jaw is complete. If we may rely upon the legend accompanying the figures in Sellard's paper (no measurements are given), the present jaw is somewhat larger than his specimen, since it measures 21.5 cm. from the middle of the broken first dental fossa in a straight line to the posterior margin of the jaw, and the height from the tip of the coronoid process to the lower margin of the mandible is 14.8 cm.

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JACKING IN EAST INDIAN JUNGLES

BY HARRY C. RAVEN

Shortly after my arrival in eastern Dutch Borneo I was introduced to the sport of "jacking," that is, hunting by night with a reflector lamp. At Samarinda I became acquainted with Mr. W. C. C. Olmeyer, whose father's deeds, by the way, furnished Joseph Conrad the plot for his novel "Almeyer's Folly." To shoot the shy sambur deer at night was one of Mr. Olmeyer's hobbies. I soon realized that this method of pursuit in the dead of night offered splendid opportunities to the naturalist. He who confines his activities to the day time faces a well nigh impossible task to gather first hand information about the habits of many animals, for in these tropical jungles few of them are seen by even the keenest observers. After dusk, however, the hunter, armed with a reflector lamp, can approach the shyest as well as the most dangerous of animals with little trouble. The glare of the light directed at their eyes renders him completely invisible to them.

One night Mr. Olmeyer had heard that a "musang," a species of viverrid, had been killing fowls in a neighbor's coop. He proposed that I join him in hunting the offender. At about eight o'clock we set out, my companion carrying his reflector lamp and armed with a shotgun. Before starting he showed me how brightly the eyes of animals appeared by flashing the light at the cats and dogs about the place. Their eyes glistened like balls of fire but could only be seen by those close behind the lamp, for the reflection from the eyes of an animal is straight back towards the source of light.

Within less than ten minutes we found the "musang" stealing noiselessly towards the chicken coop. Out of the forest, only a couple of hundred yards from the house, it stealthily passed along the ditch

bordering a banana patch. We kept very quiet, for the "musang" was coming slowly in our direction.

It stopped every few steps, and stared at the light, its eyes glowing like bright patches of yellow flame. Sometimes we lost sight of the chicken thief, but as we shifted the lamp from side to side the gleam of its eyes reappeared whenever it emerged from between the bananas or from behind the fence. Apparently undisturbed by our presence it came closer and closer and, at thirty feet, received the full charge of shot. I was greatly delighted to add to my collections such a fine specimen of *Paguma*.

Next morning, at the Chinese shops, I bought my own equipment for jacking; an imported Belgian wall lamp with a six-inch reflector, a round wick, and a cylindrical glass chimney eight inches long with the lower two inches slightly larger. The base in form of a truncate cone held oil for eight or nine hours' use. The only drawbacks to it as a hunting lamp were that the glass chimney would easily crack when drops of moisture fell upon it and that any strong wind would extinguish the flame. In spite of these deficiencies, my six and a half years' subsequent experiences in Borneo and Celebes, and one year in Africa, taught me that in open fields such a simple oil lamp is recommendable. But in the forests or in caves an acetylene lamp which can be tilted up or down is preferable, as is also the case on rivers where frequent splashes due to encounters with crocodiles may crack the chimney. In out of the way places, however, carbide is not so easily procured as is oil.

Having procured the above mentioned lamp for use in the jungle I sailed out of the Mahakkam River, and northward along the Bornean coast for about three hundred miles, in a small prahu with some Moros who, originally from the Philippines, were at that time living on a little island near the mouth of the Berau River. I intended buying a boat and hiring a crew of my own, when I reached the island for which we were bound, and had with me a Chinese boy whom I had brought as my cook. The trip to the island, the buying of the boat, and the gathering together of the men who were to accompany me were all very interesting, and I was soon ready to set out. Our first camp on the mainland of Borneo was at a place called Tandjong Batoe, a long, low point that is just north of the mouth of the Berau River. There the forest has to some extent been driven back from the shore for the natives have, for years past, been in the habit of making plantings of rice and cassava at the edge of the jungle. They burn the grass during the latter part of the south-east monsoon in August or September,

thus increasing the grassy area and, unintentionally, making a better feeding ground for the large sambar deer (*Cervus equinus*). The moon was waning and did not rise until about nine o'clock in the evening so until that hour the darkness was suitable for hunting. The natives had informed me that it was impossible to hunt on moonlight nights, and this statement was corroborated by my friend Olmeyer, who told me that when the moonlight was bright the animals were able to see the hunter and would clear off before he could approach within shooting range. However, my own experience did not bear this out for I found that the reflector lamp was a complete shield to the person behind it. Though he could easily distinguish the animal in the moonlight, the hunter was quite invisible providing he kept directly behind his lamp.

Half an hour after the sun had set the darkness was complete. The natives informed me that the "paiaw," as the sambar deer is called locally, did not come out of the forests before eight or nine o'clock and it would be useless to start hunting before that time. Our camp was at the edge of the water at high tide so when all was ready we walked along the shore for a quarter of a mile or more, in order that we might be able to walk back through the open grass and cleared country to windward, for of course it would be hopeless to try to approach any animals if they were to leeward and could get scent of us. The coast at Tandjong Batoe is low and mostly level. When the leeward end of the grassy area had been reached we halted on the beach to light our reflector lamp. I decided that I preferred to carry the lamp and have the boys walk in a line behind me, with the one nearest to me carrying my rifle. It was agreed that if a deer was seen, all the other boys should stay behind and only the gun bearer follow close to me as we approached the deer; that when I decided the animal was close enough to shoot, I would give the lamp to the gun bearer and take the rifle from him.

As we started in from the shore we carefully wended our way through a mass of thorny bushes and tangled creepers and then came to a plain about a third of a mile wide by perhaps a mile and a half long, level for the most part and covered with long coarse grass known to the Malays as "alang alang." Here and there were scattered a few forest trees, usually with a mass of vines and bushes about their trunks, and also some isolated coconut trees which had been planted by the people who had originally cleared the point. There was not a sign of a trail and we wandered about through the thick grass that on the little knolls came up to our waists, and, in the hollows, reached above our heads.

We were crossing a large level part of the plain when, a little to one side and about three hundred yards ahead, I caught a glint of light; a few steps further, and I could distinctly see the reflection of four eyes. I held the lamp so that the boy carrying the rifle could see the tiny yellow balls of fire, just the color of a flame from an ordinary oil lamp. He said excitedly in a loud whisper "*paiaw dua, Tuan*" (two sambur, Mister), and then turning to the boys strung out behind him hurriedly whispered his information several times. At the same time I was telling them to be quiet lest the animals run away.

With the lamp held high, on or slightly above the level of my eyes, I began to go forward, at first very slowly and then, finding that I was more sure footed if going a little faster, I increased my speed. The deer seemed to be getting nervous and could be seen shifting their position, though as yet all that was visible was the reflection of the eyes. We were getting closer and the eyes appeared much brighter when I nearly spoiled our plans by stumbling into a muddy ditch about three feet deep. I managed to keep from dropping or breaking the lamp, however, and went on until, with a thrilling, whistling call, one of the deer turned and bounded away, but only for a few yards for it stopped and we could again see its brightly reflected eyes as it turned towards us. I approached until I could very faintly see the outline of the animal and immediately handed the lamp to the boy from whom I received my rifle. The boy stood to my left and the light from the lamp shone on the fore sight of the rifle. When the sound of the shot died away we could hear the stamping of only one deer as it bounded off into the darkness. The other was dead, the bullet having passed through the anterior part of its back almost at the base of its neck.

At Karang Tigau, another camp farther north along the coast, where I stayed for about a month at the mouth of a little river, I did a great deal of hunting at night. At this place or near it there were no native habitations, and for the month that we remained we saw no one. I had with me a Chinese boy and three sea-faring Malays, or Bajau, as they are called.

The forest at Karang Tigau was virgin and tropical and came right down to the edge of the water. At high tide the branches of some of the trees actually dipped their ends into the water which covered the sandy beach up to the line of drift. Most of my time during the first few days at this camp was occupied so fully in setting lines of traps and preparing specimens that the only hunting I did at night was to go

along the beach near the mouth of the river shortly after dark and shine the light on the water to detect fishes. Then one of my natives would throw a circular casting net and sometimes catch a bucket full of mullet-like fish at one throw.

Later on, however, I hunted nearly every night and the first time that I went out with the lamp and the gun I shot five mouse-deer within a few minutes, and within five hundred yards of camp. These little animals, which are chiefly nocturnal, are so protectively colored that during the day time they are extremely difficult to find, and, when disturbed, disappear from sight very quickly in the heavy forest which they inhabit. The natives usually hunt them with dogs. I have seen one of these animals, pursued by dogs, jump into a large river and immediately disappear beneath the surface, not coming up until it had gone about twenty yards. Then it continued, swimming on the surface until the other side of the river had been gained. On the beach at Karang Tigau where I hunted these little deer, they were usually to be found about eight or nine o'clock in the evening lying down just inside the edge of the forest, and unless the wind was unfavorable or one made some unusual noise they would pay no attention to the light. I have often approached within from six to ten feet and stood watching them ruminating. Earlier in the evening, or just after dark, they would be found walking about in the forest and if there were any wild fig trees about with ripe fruit they would be almost sure to come to feed on the fruit which had fallen.

In going up the Berau River of northeastern Borneo, I found most of the country about the delta very low and much of it swamp, overgrown with nipa palms (*Nipa fruticans*). With me on my large and clumsy sea-going prahu, were four Malays whose duty it was to row, paddle, and pole the boat. Tandjong Redeb is the principal and only real village on the river and is located about thirty-five miles from the sea. After going up-stream above Tandjong Redeb for one day's journey we passed a few clearings along the banks of the river and then for fifteen days we paddled and poled against the current of this great, beautiful, tropical stream walled in on either side by the finest of tropical forests which continued unbroken, for there was not a single native clearing, not even a hut along the banks. Behind the large prahu, we were towing a small and narrow dug-out canoe. Nearly every night on our journey up the river I took the gun and reflector lamp and hunted along the banks of the river, paddling for hours up the stream and then drifting down with the current, the whole time playing the rays of the

lamp about the banks, under the overhanging trees, between great logs and masses of roots, and up the mouths of little streamlets, even shining it high up into the great dark masses of foliage of the giants of the forest, and down into the muddy waters below.

As soon as I became accustomed to hunting at night, in order to get better results I told my natives that they must never speak while we were hunting; I sat cross legged in the bow of the canoe and, if I saw an animal, directed the rays of the lamp toward it and shook the canoe slightly as a signal to the men that they were to paddle in the direction which I thus indicated. They were not even to raise their paddles to the surface of the water lest the drip cause a sound, ever so slight, yet enough, in the stillness of the night, to arouse the suspicions or cause the flight of a wary animal.

Until this trip up the Berau River I had had no experience with crocodiles, though of course I had heard many very terrible stories about these animals from the natives and sometimes from whites as well. My first experience with a crocodile occurred one night while I was being paddled along close to the bank of the river. It was with the expectation of finding such animals as civets, jungle cats, mouse-deer, muntjac, sambur, and pigs that nightly excursions of this kind were undertaken. The canoe glided noiselessly along. Behind me were seated three Malays, one in the stern, one in the center of the canoe, and the third close behind me in the bow. The branches of the trees hung far out over the water and there were many partly submerged logs and snags. It was among these that I caught sight of the reflection from the eye of a crocodile. The reptile was headed up stream the way we were going. Holding the lamp high, I pointed with my finger at the animal hoping that the natives would see it, but they did not and as we were getting very close to it I picked up the shotgun (12 bore hammerless) which could be easily manipulated with one hand. The canoe was very flat, no part of it more than six or eight inches above the level of the water. When the bow of the canoe was within about ten or twelve feet of the head of the crocodile I fired. Only the upper part of the head with its eyes and nostrils was above the surface of the water. It seemed that simultaneously with the report of the gun there was a great splash and the next instant we were covered with spray, which broke the chimney of the lamp and nearly extinguished it. Evidently the coarse shot had glanced off the hard bones of the skull for the creature gave one great lunge and disappeared beneath the surface of the muddy water. We returned to the bigger boat and

secured a new lamp chimney and then continued our hunt for other animals. After several more experiences with crocodiles, my natives came to me and said that if I was going to continue to shoot crocodiles from a small canoe they wanted to leave my service, for they said that crocodiles had often overturned canoes and then eaten the occupants. When informed that I would be careful and that I did not intend to shoot any more crocodiles at such close range they were satisfied for the time being.

Some of the natives were very enthusiastic about hunting at night and were always delighted when they learned that I was going; others seemed to think that it was a useless sort of thing to do as the animals usually obtained were of no use to them for food, though the Dyaks as a rule would eat almost any kind of meat. On one occasion I found a group of proboscis monkeys (*Nasalis larvatus*) sleeping in the trees that overhung the river, and by getting nearly under them and playing the light on them from below for a few moments and then turning it aside for a few seconds so confused the monkeys that when we made a noise below by shouting and clapping the paddles on the water they jumped about from branch to branch. Two fell from their high perches. One caught on some lower branches and the other came down into the water and, as it was a large one was shot as it climbed out on the branches protruding from the bank.

Early in 1914 I made a trip up the Mahakkam River. It was possible to have my houseboat-like prahu of a sea-going type towed up the river as far as Long Iram by a small steamer. At Long Iram the Dutch Official, Captain Muller, very generously helped me to procure Dyaks as paddlers and loaned me a long canoe in which to travel to a Dyak village known as Long Hurei. At this place, where I found Bahau Dyaks, I sent the long canoe back to Long Iram and secured from the Bahau three smaller canoes and some of their people to take me up Long Merah, a river confluent with the Mahakkam above Long Hurei and coming in from the northward. After two days of paddling against the current and poling up rapids, the Bahau brought me to a temporary dwelling place of some Punans or nomadic Dyaks. I wished to camp among the Punans for a time, so the morning after our arrival my Bahau friends departed and I told them that when I wanted them to return for me I would send one of the Punans down to bring them word.

For a few days I camped with the Punans and then moved about half a mile down stream and made camp on the opposite bank of the river. While encamped here in the absolutely virgin forest where the

sunlight filtered through the dense foliage in slender beams of light, I shot and trapped by day and hunted with the light at night either by following the little trails made through the forest or, as proved to be more profitable, by paddling and poling on the river seated in the bow of the narrow canoe. The Punans would either squat behind me to paddle or stand to pole and maneuver the canoe where there were rapids, or where fallen trees had blocked part of the passage. I remember very distinctly that on one occasion we were quietly drifting down stream and not a word had been spoken since we left camp. The Punans stood up and took the poles and I knew we were approaching rapids. The banks of the river were rather high at this particular spot and the tall trees in some places formed an arch over the river. Long lianas hung down from branches high over the river and the roots trailed and swayed in the swiftly flowing stream. The canoe started down the rapids, guided skillfully between the rocks and away from the breakers, which, although only a few inches in height, would have been sufficient to swamp it. I continually played the rays of light from the lamp along the banks and over the river. As we were nearing the lower end of the rapids I caught the reflection of the eye of an animal ahead and to my left. The canoe was gliding swiftly, so holding the light with my left hand I grabbed my shot gun with my right, raised and fired it quickly just as the canoe was swept down the last of the rapids and came out on a sleek quiet pool where the river was somewhat wider. I then spoke to the Punans telling them that I had shot some kind of a cat for the eye had appeared bright and white. They were much surprised for they had seen nothing. They spun the canoe around and when it came along side the bank I carefully replaced my gun in the bow, after having reloaded it, and climbed out on the roots which overhung the bank. The Punans seemed surprised that I put my gun down and asked if I were not going to take it, to which I replied with calm assurance that I could tell by the reflection of the eyes that the animal was only a cat. I clambered over a mass of roots, vines, clay, rocks and dead leaves to the top of the bank fifteen or twenty feet above the river and then just as I put my hand over the broad flat buttress-like root of a large tree I touched a warm and furry body and saw before me the animal I had shot, *Felis nebulosa*, the clouded leopard, the largest of the Felidæ to be found in Borneo. It is one of the most beautiful members of the cat family, with a pattern of grays and black, somber yet handsome.

One of my Punan friends who accompanied me was a sturdy young chap named Lekio who owned a very fine "mandau," a short sword with a blade which is flat or hollow, ground on one side and rounded on the other side. His sword, which he had gotten from a Kenyah in exchange for two dogs, he prized very highly and would not sell for anything that I had to give him. However, when I shot the clouded leopard, he and all the other Punans were greatly surprised for these animals are rare. Lekio immediately began to beg for the canines of my prize, but I explained to him that I could not take out the canines without spoiling the skull for my purpose. Nevertheless he continued to beg for the teeth until he got so excited that his whole sturdy muscular body was covered with perspiration and he went away telling me and his companions that I was absolutely without pity, for he believed that the teeth which he wanted would protect him from the head-hunters of other tribes. To find out how much he valued the teeth I asked him if he would give me his "mandau" in exchange for them. He immediately brought his weapon to me but I told him I valued the perfect skull more than his "mandau" and could not exchange with him.

I was surprised to find that the reflection of the eyes of nearly all nocturnal animals could easily be seen with the light and that the different species showed considerable variation. The eyes of most insects, such as moths and butterflies, reflect a pink or reddish light, as do spiders, crawfishes, and fishes. The deer, muntjac and *Tragulus* reflect an even yellow light like the flame of an oil lamp. The wild pigs reflect a pinkish light that is rather weak and always looks small. The banteng (*Bos sondaicus*) gives a bright reflection, very pale yellowish or greenish in color, sometimes almost white.

The size of an animal may be judged by the distance between its eyes. If by chance, as sometimes happened, several deer were before the light at one time it was possible to pick out the buck because of the greater width of the head and consequently the greater distance between the eyes. The color of the reflection from the eyes, the size, the distance apart, and the height above the ground frequently furnished evidence enough so that it was possible to tell what kind of animal was being approached. Of course at first, night hawks sitting on low branches or logs would be mistaken for deer or sometimes for a civet, but it was soon learned that mammals invariably move about and do not keep the head in one position for more than a few seconds, as do the birds and reptiles.

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NOTES ON THE MAMMALS OF NORTHERN LAKE COUNTY,
MINNESOTA

BY CHARLES EUGENE JOHNSON

Lake County, Minnesota, lies well within the Canadian life zone. Its northern two-thirds, approximately, is in the Hudson's Bay drainage basin. The portion with which the following notes are concerned is included in what is known as the Superior National Forest and is a large forest-covered area the surface of which is somewhat hilly and rough but abundantly supplied with lakes and streams. The principal forest trees are spruce, jack-pine, balsam fir, cedar, a certain amount of Norway pine and white pine, and birch and poplar. Dense growths of alder fringe many of the streams but here and there the water courses are bordered by strips of marsh land of varying widths; and bogs and swamps are of frequent occurrence. Altogether there is a considerable variety of habitat so that the region is in many respects ideal as a wild life preserve. It is uninhabited and conditions are essentially undisturbed by man except in one or two portions where the timber had been removed a good many years ago, or more recently as indicated subsequently. Since the area was made a forest and game preserve some ten or more years ago the wild life within it has enjoyed full protection, but previous to that time it had been extensively trapped. Very recently a limited number of reliable trappers have been licensed by the State Game Commissioner to enter the territory to trap wolves and also a number of other carnivorous fur-bearers which were believed to be sufficiently plentiful to warrant a certain amount of trapping.

The following list, with the exceptions therein stated, contains the mammalian species observed and taken by me personally in the course of a number of summers devoted principally to motion-picture photography of Minnesota big game, under the patronage of Mr. James F. Bell of Minneapolis. This work was carried on during the seasons of 1912 to 1915 inclusive and the specimens taken within this period are in the collections of the Zoological Museum, University of Minnesota. In the latter part of last summer (1920) I returned to this region for a brief survey of the territory covered in the previous years and some of the changes that had taken place are remarked upon later in this paper. For some of the smaller mammals listed the present records are too meager to establish either their relative abundance or their distribution within the area in question. It is my hope, however, if opportunity offers, to add to these notes in the future.

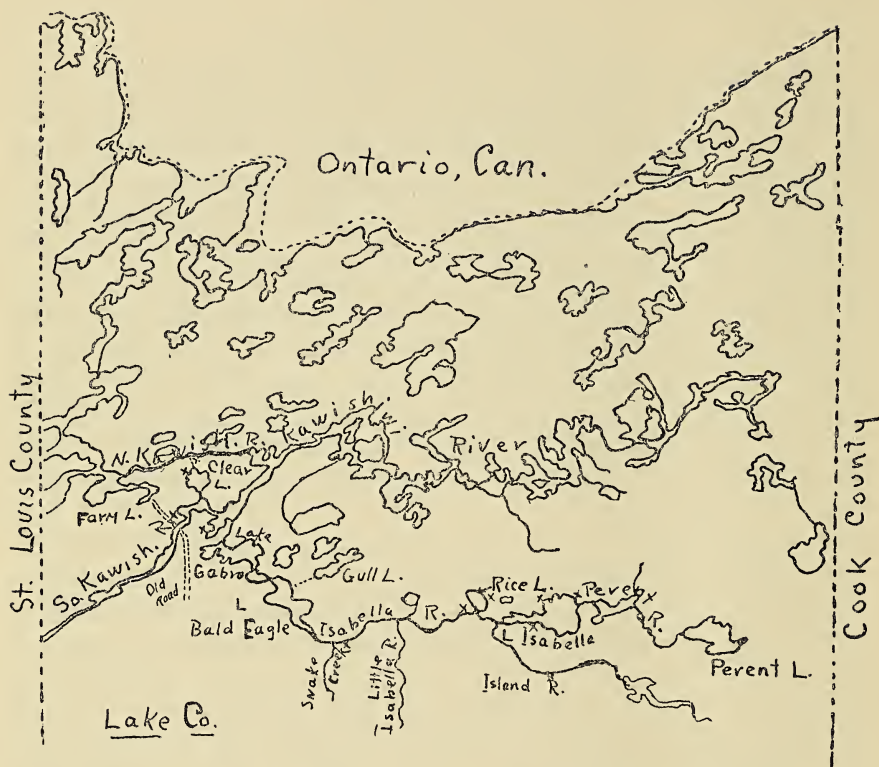


FIG. 1. OUTLINE MAP OF NORTHERN LAKE COUNTY, MINNESOTA, SHOWING PRINCIPAL LOCALITIES MENTIONED IN THE TEXT

The accompanying outline map is included for the purpose merely of indicating the principal localities mentioned in the text.

Specimens of *Tamias*, *Eutamias*, *Peromyscus*, *Eutamias*, *Microtus*, *Synaptomys*, and *Mustela cicognanii* have been examined and identified as listed, by the U. S. Biological Survey. In regard to the beaver of this region, it is possible that it is to be assigned to the rather recently described subspecies *michiganensis* of Bailey, but this awaits verification by actual comparison.

Odocoileus virginianus borealis. Northern White-tailed Deer.—Common. A total of 132 deer was seen, among which were 38 bucks, 63 does, 12 fawns and 19 which could not be identified as to sex. More deer were always seen in the closer-in localities than in the more remote parts where the timber wolf no doubt was largely responsible for their smaller numbers as well as their greater wariness. Along the water courses of this region are numerous little grassy bays which are much sought as feeding grounds by the deer. A number of times deer were met with on islands, in both lakes and rivers, some of them no more than an acre or two in size, and none more than fifty or seventy-five yards distant from the mainland. The animals probably had become accustomed to a sense of security on these islands and sought them for resting places, for they had but little attractiveness as feeding grounds. Specimens from N. and S. Kawishiwi districts; L. Isabella.

Alces americanus. Moose.—When I first entered this region, in 1912, moose were very common in the North and the South Kawishiwi River district, and eastward and southeastward as far as our observations extended, namely to the Perent River. Also during the three seasons that followed moose were plentiful and distinctly appeared to be increasing. In 1915 alone, during a period of about nine weeks, 132 moose were seen and trails and wallows were abundant about the water courses. I did not visit the region again until the summer of 1920, when, to my surprise and disappointment I met with a total of only 5 moose from July 26 to September 4. Signs seemed to indicate that the bulk of the moose population had deserted the territory. Many of their favorite feeding grounds of former years bore no signs of having been frequented by moose this season. It is my belief that this disappearance of the moose was the result chiefly of disturbances due to logging operations that had been carried on in the intervening period, along the North and South Forks of the Kawishiwi and along the main stream further eastward. If this be true then one may hope for a gradual return of the moose with the restoration of normal quiet. Specimens from Clear L.; S. Kawishiwi; L. Bald Eagle.

Rangifer caribou caribou. Woodland Caribou.—I have personally no positive evidence of the presence of caribou in the part of Lake County covered by these notes. However, at Saw Bill Lake in Cook County, about six or eight miles from the eastern border of Lake County, it was reported to me by Mr. Leslie Brownell, then forest supervisor, that a number of caribou had been seen in the winter of 1917. Mr. R. G. Schreck, present acting supervisor, reports that a number of caribou are still found in that same general region.

According to Mr. John Schafer, municipal judge of Ely, caribou were common along the Kawishiwi River in Lake County, twenty years ago, being found as far westward as Farm Lake. He mounted several heads from specimens killed in Twp. 63, R. 10, in this county. Logging then began and the animals left the district.

Glaucomys sabrinus sabrinus. Northern Flying Squirrel.—August 23, 1913, a male was trapped on the ground at the foot of a cedar, at the lower end of the first rapids of the Isabella River above Lake Bald Eagle. September 4 a female was taken on a fallen log about 30 rods distant from this place. These were the only specimens secured, but the species is probably of regular occurrence in suitable localities throughout the region.

Sciurus hudsonicus hudsonicus. Red Squirrel.—Of general occurrence in this territory but in no locality visited did the species seem to be plentiful. The squirrels were most in evidence in localities where cedars occurred. On the seeds of these trees the animals always seemed to feed abundantly and the ground in such places was often literally covered with cedar cones. The species as a rule was found very quiet in this region, rarely indulging in its scolding chatter. Specimens taken on the North Kawishiwi—Clear Lake portage; at the outlet of Lake Bald Eagle; at the Isabella River rapids at Bald Eagle; and at Rice Lake.

Tamias striatus griseus. Gray Chipmunk.—Common in suitable localities throughout the region. Specimens taken on the North Kawishiwi—Clear Lake portage; on the South Kawishiwi in the Clear Lake region; at the Isabella River rapids at Bald Eagle.

Eutamias borealis neglectus. Long-tailed Chipmunk.—Found in all the localities in which the preceding species occurred, and apparently was more numerous; it was certainly more in evidence. Several of each species usually congregated about our camp wherever we remained for any length of time. At one point where a trail crew had left a peck of oats in a box, a half dozen or more of each kind often feasted together in reasonable harmony while it lasted, but the smaller species seemed to have some fear of the larger. Specimens from the same localities as for *Tamias*.

Marmota monax canadensis. Canada Woodchuck.—While apparently of general distribution it was nowhere found to be very common. A specimen was taken June 19, on the north shore of Clear Lake; it apparently had its den in a crevice among some rocks. A half-grown specimen in the black phase was taken along the South Kawishiwi, July 24. Other localities where records were obtained are: north shore of Gabro Lake, specimen shot July 31; Isabella River rapids at Bald Eagle, one seen August 15; northeast shore of Lake Isabella, specimen shot by Prof. N. L. Huff, August 28. The first three records are for 1912, the last two for 1913 and 1914 respectively.

Castor canadensis. Beaver.—In 1912 no recent signs of beavers were found along the route followed from the North Kawishiwi southeastward, until we reached the Little Isabella River, although careful scrutiny was made along all the water courses between these two points. Along the Little Isabella, however, many fresh workings were located, evidently of animals that had come down from the headwaters of this stream where a colony was known to have existed a year or two before. The following season a new lodge was discovered down stream on the Isabella River, about a mile above Bald Eagle, and in 1914 and 1915 very notable extensions of operations were observed along the Isabella from this point eastward nearly to Perent Lake; while a single lodge had been built at "Dead Man's Rapids" on the North Kawishiwi. When I returned to this territory in 1920 it was apparent immediately that a great spread of the beaver had taken place during the intervening period. More than a score of lodges were located beyond those recorded in 1915 and as time did not permit our covering all of the localities examined in that season there is no doubt that many more might have been found. In addition to lodges there were of course many new operations such as dams and cuttings, and numerous beavers were seen. Several lodges of the former years were still occupied and had grown to much larger dimensions. On August 2 a young beaver about the size of a full-grown muskrat

was surprised and caught in the hand near one of the recently built lodges. Specimens from L. Isabella; L. Bald Eagle; Isabella River.

Peromyscus maniculatus gracilis. Deer Mouse.—Abundant in all parts of the territory. This species was taken in a variety of situations such as the exposed floor of deep woods, in open grassy places, on fallen logs and under logs, and one specimen was taken on the limb of a cedar about four feet from the ground. Two stomachs that were opened contained green vegetable matter, seeds, the remains of some insect larvæ and shields and other skeletal parts of insects.

Evotomys gapperi loringi. Red-backed Vole.—It is a question in my mind whether this or the preceding species should be given first place in point of numbers. Both were found a nuisance because of the frequency with which they got into the traps and interfered with the catching of more desirable species. The red-backed vole was taken in broad grassy meadows bordering water courses, on exposed rock outcrops, in boggy places within the deeper woods, on logs and under logs and over the forest floor generally. June 25 a female was taken which contained 8 embryos in early stages of development; another pregnant female was taken August 4.

Microtus pennsylvanicus pennsylvanicus. Meadow Mouse.—This mouse was not found to be very common but may be more plentiful than the results of the trapping would seem to indicate. Specimens were taken in the following localities: North Kawishiwi end of the Clear Lake portage; on an old logging road where it crosses the South Kawishiwi west of Clear Lake; along Snake Creek near L. Bald Eagle; on the second portage of the Isabella above Bald Eagle.

Ondatra zibethica zibethica. Muskrat.—Common along the streams. The muskrat rarely builds its characteristic "houses" in this region, the animals living usually in bank burrows, and in some localities apparently among rock crevices at the edge of the water. July 23 five young about one-third grown were taken at a "house" on the North Kawishiwi a short distance above "Dead Man's Rapids;" and on the same day in a nearby locality a female was taken which contained 7 fetuses about the size of the common house mouse. The muskrats in this locality had been cutting down some young shoots of poplar, about the size of a lead pencil in thickness, from which the leaves had been stripped and eaten, as was shown by the stomach contents. I employed such shoots and also those of dwarf maple successfully as bait in trapping the muskrat in this and other localities.

Synaptomys fatuus. Bog-lemming.—A single specimen of this species, a male, was taken among some dense, small shrubbery at the edge of the water, at the North Kawishiwi end of the Clear Lake portage, July 1, 1912. Continued trapping in the same locality failed to obtain more, nor were specimens secured elsewhere; but trapping on a larger scale would no doubt prove the species to be of regular occurrence in this region.

Zapus hudsonius hudsonius. Jumping Mouse.—Probably occurs throughout the region, in suitable localities. July 25, 1915, a jumping mouse was seen on a dry grassy knoll near the south bank of the Isabella River opposite Rice Lake. In August, 1920, a specimen was taken in a dry grassy spot at the first portage landing above Rice Lake.

Erethizon dorsatum dorsatum. Canada Porcupine.—Fairly common. The majority of the porcupines seen were met with while they were feeding at the edge of some lake or stream. In a number of instances they were observed eating the rhizomes of water-lilies that had been pulled up by the moose. The porcupines were at times seen to secure this food, and no doubt also other kinds found in such places, by reaching down into the water full length of the arm, feeling about until some object was encountered and then hauling it in with the hand. Half grown specimens still accompanied by the mother were several times met with.

Lepus americanus phæonotus. Minnesota Varying Hare.—Found throughout the region but it was much more common in the underbrush along the North Kawishiwi and in the Clear Lake district than further out, as for example in the Isabella Lake region. This is very likely due to the greater number of enemies preying upon the species in the more remote localities.

Lynx canadensis canadensis. Canada Lynx.—I was informed by Fred Mayo, one of the trappers in this territory, that only once during the trapping season of 1919–20 did he come upon tracks of the lynx; he considered the species rare, having failed to secure a specimen during his trapping experience in this range. I was informed by Mr. John Schaefer that lynx are still occasionally brought in from other parts of Lake County.

Lynx rufus rufus. Wild Cat.—The only evidence I have personally obtained of the presence of the wild cat in this particular part of the county is the record among my notes of an old skull picked up in 1912 near the junction of the Island River with the Isabella. Neither of the two trappers had taken or seen any specimens of the wild cat in their operations of 1919, but Mr. R. G. Schreck informs me that the species is quite certainly present although scarce.

Vulpes fulva. Red Fox.—The red fox occurs in all parts of this territory, apparently in moderate numbers only. One of the trappers considered it fairly common in the Kawishiwi River and Gabro Lake districts; the other held it to be rather scarce in the Isabella River and Lake region. My own evidence is limited to three foxes seen, two of which were taken; one of the specimens was a black phase. The localities are: The South Kawishiwi about a mile below Clear Lake; the hill bordering the bay of the S. Kawishiwi southwest of the Gabro Lake portage (black specimen); Isabella River about half a mile below L. Isabella.

Canis nubilus. Timber Wolf.—Found in all parts of this territory but more especially in the remoter districts. Signs of the timber wolf were frequently met with from the Gabro Lake region eastward and southeastward as far as my observations extended. In September, 1912, I chanced upon one of these beasts while it was feeding upon a dead moose at the rapids of the Isabella River at Lake Bald Eagle; and in August, 1920, I shot an immature male along this same river at Rice Lake (Johnson, Journ. of Mammalogy, Feb., 1921). One of the trappers reported having seen a number of packs of wolves in this region in the winter of 1919–20. Each of the men had taken about half a dozen of the animals in their trapping operations that season. The total destruction of big game by the timber wolf in this entire region is unquestionably quite considerable.

Lutra canadensis canadensis. Otter.—The first signs of otters in the territory covered were seen in 1914, along the Isabella River at the first portage above Rice Lake. Here was found a recently inhabited den and also other evidence

of the presence of otters during that season. The animals themselves, however, were not seen and no attempt was made to trap for them. August 16, 1920, a female accompanied by two young was seen in the Isabella River about a mile below Isabella Lake; and on August 22, an adult accompanied by one young was seen in a beaver pond on a small stream entering Isabella Lake on the northeast shore. With continuation of the protection that the otter has enjoyed in the region for a number of years past, the species may be expected to show a steady increase.

Mephitis hudsonica. Northern Plains Skunk.—My only record is for a female specimen taken at the mouth of a small stream entering the North Kawishiwi from the north, just above "Dead Man's Rapids," June 26, 1912.

Mustela vison vison. Mink.—More or less common in all parts of this region. In addition to a number of minks seen at various times in other parts of the territory, specimens were taken in the following localities: West shore of Lake Bald Eagle; the junction of Snake Creek with the Isabella; the upper end of the rapids of the Isabella at Bald Eagle; north shore of Lake Isabella.

Mustela cicognanii cicognanii. Common Weasel.—A female of this species was taken by one of my companions, Mr. R. C. Chapman, along the Isabella River about half a mile above Bald Eagle, August 20, 1912; in August, 1920, I saw two of these weasels at the rapids above the locality mentioned. Trapper Mayo reported the species as occurring in moderate numbers during the trapping season.

Martes americana americana. Marten.—Mr. R. G. Schreck reports the marten as present but very scarce in other portions of northern Lake County but in the part visited by me I have no evidence of its occurrence; the two trappers mentioned stated that they had not secured any specimens of this species.

Martes pennanti pennanti. Fisher.—The trappers reported that each had taken a number of fishers during the winter of 1919-20, and considered the species generally distributed throughout the greater part of this territory.

Ursus americanus americanus. Black Bear.—Fairly common and, I believe, increasing. In addition to many signs found in various parts of the region visited, bears were seen in the following localities: 1912, northwest shore of Gabro Lake; 1913, rapids of the Isabella at Bald Eagle; 1914, North Kawishiwi River about a mile east of Farm Lake, and the northwest shore of L. Isabella (specimen); 1915, Isabella River just below Pike Falls; 1920, Island River at the first long rapids above its mouth.

Sorex personatus personatus. Common Shrew.—A specimen was taken August 24, 1914, on a point of land covered with birch, poplar, spruce and balsam fir, on the east shore of Lake Isabella. The presence of the shrew was suspected in many other localities but the traps employed were rather ill adapted to the capture of these tiny mammals and this probably accounts largely for the meagerness of the catch. The species is undoubtedly of general occurrence in all this region.

Sorex richardsonii. Black-backed Shrew.—A single specimen was taken in 1915, in a bog on the northwest shore of Clear Lake. The species is probably of general occurrence.

Department of Zoology, University of Kansas, Lawrence, Kans.

TWO NEW SKUNKS OF THE GENUS *CONEPATUS*

BY E. A. GOLDMAN

Skunks of the genus *Conepatus* are as a rule far less numerous than are those of the genera *Mephitis* and *Spilogale* which over a wide area, embracing most of Mexico and sections of the southwestern United States, may occur at the same localities. Study of slowly accumulated material assignable to this unrevised genus has resulted in the discovery of two hitherto unrecognized geographic races which are described below.

Conepatus mesoleucus venaticus subsp. nov.

ARIZONA HOG-NOSED SKUNK

Type from Blue River (Casper Ranch), 12 miles south of Blue, Arizona (altitude 5000 feet). No. 205376, ♂ old adult, U. S. National Museum (Biological Survey Collection), collected by E. A. Goldman, September 1, 1914. Original number 22459.

Distribution.—Southeastern Arizona and adjacent parts of New Mexico, Sonora and Chihuahua, mainly in Upper and Lower Sonoran Zones.

General characters.—A rather small form most closely allied to *C. m. mearnsi*; general size and color similar; skull decidedly narrower and differing in detail.

Color (type).—Top of head, upper surface of neck, back, and tail above and below, white, the tail with a thin admixture of dark hairs along median portion; face, sides of neck, flanks, fore and hind legs and underparts black as usual in the group.

Skull.—Closely resembling that of *C. m. mearnsi*, but narrower throughout; braincase smaller, less expanded; zygomatics less widely spreading; interorbital region more constricted; interpterygoid fossa narrower; nasals narrower; audital bullæ variable, but usually slightly smaller, less inflated; sagittal crest in adult males very prominent; dentition about as in *mearnsi* (less heavy than in *C. m. mesoleucus*).

Measurements (type).—Total length, 630; tail vertebrae, 230; hind foot, 76. An adult female topotype, 585, 255, 70. Average and extremes of 2 adult males from Graham Mountains, Arizona, 640 (640–640); 255 (250–260); 73.5 (73–74).

Skull (type).—Greatest length, 72.9 (median line); condylobasal length, 70.2; zygomatic breadth, 49.4; interorbital breadth, 18.6; width of braincase at constriction behind zygomatics, 37.4; mastoidal breadth, 42.7; median width of interpterygoid fossa, 6.6; front of canine to back of large upper molar, 22.4; length of upper incisor series at cingula, 11.

Remarks.—Specimens from Diamond Creek and head of Mimbres River, New Mexico, assigned to *C. m. mearnsi* are very variable and indicate intergradation with *C. m. venaticus*. From its geographic neighbor on the south, *C. sonoriensis*, the Arizona form differs markedly in the smaller size of the skull, with relatively longer, narrower nasals and narrower interpterygoid space. The extension of white of upper parts is variable as usual in the species. It usually

forms a broad mantle reaching in some specimens well down along flanks. In some individuals there is a white spot on the throat, and the ears may be whitish.

Specimens examined.—Total number, 22, from the following localities:

ARIZONA: Blue River (type locality), 5; Ash Creek, Graham Mountains, 2; Black River, 1; Fort Huahuaca, 1; Fort Lowell, 1; * Fort Whipple (near Prescott), 1; La Osa, 1; McMillenville, 1; Nantan Plateau, 1; Raspberry Creek, Prieto Plateau, 1; Tucson, 1.

NEW MEXICO: Animas Valley, 1; Dry Creek, 1.

CHIHUAHUA: Colonia Garcia, 2.

SONORA: Santa Cruz, 1; San Jose Mountains, 1.

***Conepatus mesoleucus nelsoni* subsp. nov.**

NELSON'S HOG-NOSED SKUNK

Type from Armeria (near Manzanillo), Colima, Mexico (altitude 200 feet).

No. $\frac{33252}{45257}$, ♂ old adult, U. S. National Museum (Biological Survey Collection), collected by E. W. Nelson, March 3, 1892. Original number 2004.

Distribution.—Region of the type locality in Colima and probably adjacent parts of western Mexico, Arid Tropical Zone.

General characters.—Similar to *C. m. mesoleucus*; general size and color about the same; skull narrower, less massive and differing in detail.

Color.—About as in typical *C. m. mesoleucus*, the white dorsal area somewhat variable as in that form. In the type and in a specimen from Hacienda Magdalena, Colima, the white extends entirely across the back near the middle, while in an example from Colima, Colima, the white area is considerably reduced in width.

Skull.—Compared with that of *C. m. mesoleucus* the skull in both sexes is narrower, less massive, with smaller less inflated braincase, and less widely spreading zygomata; interorbital region narrower; sagittal and lambdoid crests in type (old male) high and trenchant; frontal region depressed and dentition rather heavy, much as in *mesoleucus*.

Measurements (type).—Total length, 664; tail vertebrae, 287; hind foot, 88. Average and extremes of 2 adult females from Hacienda Magdalena and Colima, Colima, 593 (602–585); 251 (265–237); 75 (74–76). Skull (type): Greatest length (median line), 78.2; condylobasal length, 74.8; zygomatic breadth, 52; width of braincase at constriction behind zygomata, 39.5; mastoidal breadth, 45.7; median width of interpterygoid fossa, 9; front of canine to back of large upper molar, 25; length of upper incisor series at cingula, 11.5.

Remarks.—*Conepatus mesoleucus nelsoni* is a western tropical form of the species which is typical on the high plateau region of Mexico. The skull differs markedly from those of *C. leuconotus* of tropical eastern Mexico, and *C. sonoriensis* in lesser elongation, and depressed instead of highly arched frontal region.

Specimens examined.—Three, all from the state of Colima, Mexico as follows: Armeria (type locality), 1; Colima, 1; Hacienda Magdalena, 1.

Biological Survey, Washington, D. C.

* Collection of A. B. Howell.

NOTES ON THE MAMMAL FAUNA OF TSUSHIMA AND IKI ISLANDS, JAPAN

By NAGAMICHI KURODA, RIGAKUSHI, M. A. S. M.

The principal papers on the mammals of Tsushima were published by Mr. O. Thomas (Ann. & Mag. N. H., (6), XIX, p. 161, 1897; P. Z. S., p. 182, 1905; op. cit., pp. 47-54, 1908). Mr. N. Teraoka and I obtained 10 species and subspecies of mammals on that island during the last year. I have been able to add 2 species to those hitherto known from it, bringing the total number of forms to 14.

On Iki Island Mr. Thomas writes that "After Tsushima Mr. Anderson visited the Iki and Goto Islands, the resulting collections proving that those groups are absolutely similar to S. W. Japan in their mammal fauna" (P. Z. S., 1908, p. 49). Mr. H. Orii collected mammals on Iki Island and Mr. Teraoka and I also visited the island and brought back a small number (3 species) of mammals.

All the known mammal fauna of Tsushima and Iki Islands are listed and noted below.

The * mark indicates the new additions to the mammal list of both islands.

FAM. TALPIDÆ

1. *Urotrichus talpoides adversus* Thomas.—Anderson obtained this form on Tsushima (Thomas, P. Z. S., 1908, p. 49).

2. *Mogera wogura kanai* Thomas.—A specimen was presented by Mr. S. Fukagawa. It was obtained at Izugahara, Tsushima, date unknown. Mr. Teraoka collected a specimen at Nukadake-mura, Tsushima, October 27. Skulls from the above specimens are both broken. The coloration of body in Tsushima specimens varies from very pale (greyish brown or even golden color) to deep reddish brown. Holst obtained a specimen on Tsushima (Thomas, P. Z. S., 1908, p. 49).

FAM. SORICIDÆ

3. *Crocidura coreæ* Thomas.—Anderson collected it on Tsushima (Thomas, P. Z. S., 1908, p. 51). This is one of the Korean forms.

FAM. RHINOLOPHIDÆ

4. *Rhinolophus cornutus cornutus* Temminck.—Mr. Fukagawa presented to me an albino specimen of this form. It was obtained near Izugahara, Tsushima, date unknown. Mr. Teraoka collected a female on Wakamiyajima, Iki Island, November 2. Holst obtained it on Tsushima (Thomas, P. Z. S., 1908, p. 49).

*5. *Rhinolophus ferrum-equinum nippon* Temminck.—An albino specimen was presented to me by Mr. Fukagawa. It was obtained near Izugahara, Tsushima. It is probably a new addition to the mammal fauna of Tsushima.

FAM. VESPERTILIONIDÆ

*6. *Myotis tsuensis* sp. nov. Diagnosis.—General color of upper and lower parts reddish brown chestnut, somewhat lighter on the lower parts.

The type specimen was collected near Izugahara, Tsushima, date unknown, and was presented to me by Mr. Fukagawa.

Measurements, in millimeters

HEAD AND BODY	TAIL	HEAD	EAR	TRAGUS	FOREARM	THUMB	3RD FINGER	4TH FINGER	5TH FINGER	TIBIA	CALCANEUM	FOOT AND CLAW	TAIL FREE FROM MEMBRANE	TOTAL LENGTH OF SKULL	BASILAR LENGTH OF SKULL	ZYGOMATIC BREADTH OF SKULL	PRESERVED IN:
161	51.5	18.5	17	8.5	50	11.5	75	64.5	63.5	23	26	12	2.5	18	16	11	N. Kuroda's coll. Tsushima elementary school coll.
70	47	19.5	16	9	50	10	80	66.5	67	25	25	12	2.0	—	—	—	

¹ The type specimen.

The new species is probably a resident on Tsushima. It differs from *M. macrodactylus* (Temm.) from Hondo and Kiusiu by much larger body and by the color of fur. Another species is found in Kiusiu called by the name of *M. nattereric bambinus* Thos., but it has shorter forearm, 40 mm., and the calcaneum extending about halfway between the ankle and the tail, instead of extending at least three-fourths the distance between the ankle and the tail.

*7. *Miniopterus schreibersi japoniæ* Thomas.—An adult male was collected by Mr. Teraoka on Wakamiyajima, Iki, November 2. There is no difference between this specimen and specimens from Hondo, Japan.

FAM. MURIDÆ

8. *Apodemus geisha sagax* Thomas.—Mr. Teraoka obtained two specimens at Sasuna-mura, Tsushima, October 15 and at Komoda, Tsushima, October 25. Thomas reported it from the island (P. Z. S., 1908, p. 54).

9. *Apodemus speciosus speciosus* (Temminck).—Mr. Orii and Anderson obtained the specimens on Tsushima (Thomas, P. Z. S., 1908, p. 53). Mr. Orii obtained it on Iki Island.

10. *Micromys minutus aokii* subsp. nov. *Micromys minutus* (Pallas), subsp., AOKI, "Nihon san Nezumika," p. 41 (1915).

Diagnosis.—Length of head and body shorter than the length of tail; under parts of body pure white, hairs without any slate color at base; upper parts uniform russet brown; lower rump, base of tail as well as side of body rufous color; border of upper and lower parts very well defined; ear covered with russet hairs; hand and foot covered with very pale yellowish hairs; tail long and uniform pale yellowish-brown with short hairs; number of tubercles 5 on fore foot and 6 on hind foot.

The type and an adult female specimen with 5 embryos, were obtained by Mr. Y. Utano near Izugahara, Tsushima, October 29, 1920, and were sent to me by him.

Measurements, in millimeters

LOC.	HEAD AND BODY	TAIL	HIND FOOT	EAR	TOTAL LENGTH OF SKULL	BASILAR LENGTH OF SKULL	ZYGOMATIC BREADTH OF SKULL	SEX	MEASURED BY:
*Near Izugahara, Tsushima	—	75	14.5	8.5	18	15.5	10	♀	N. Kuroda
**Tsutsu-mura, Tsushima...	—	74	15.7	8.3	—	—	—	♀	Mr. Aoki
**Tsutsu-mura, Tsushima...	55	67	14	7	18.5	15.6	9.5	♀	Mr. Aoki
***Izugahara, Tsushima....	54	53	14.5	9	—	—	—	♂	Mr. Thomas

* Type. Measured on the moistened skin, ** measured on the specimens in alcohol and *** probably measured on the fresh skin.

Mr. Aoki ("Nihon san Nezumika"—Muridæ of Japan, pp. 41-45, 1915) described the new form but did not give it a name and he compared 7 other forms of *Micromys minutus*. The new form differs from *M. m. soricinus*, *M. m. pratensis*, *M. m. ussuricus*, *M. m. japonicus* and probably *M. m. minutus*, by the tail longer than head and body, except the specimen measured by Mr. Thomas which is almost in the same length (P. Z. S., 1908, p. 54). It differs from *M. m. pygmaeus*, by the under parts pure white instead of earthy color. It is probably most related with *M. m. flavus*, but it differs from the last form by the upper parts russet brown instead of bright yellow.

The subspecific name is given in honor of Mr. B. Aoki.

11. *Rattus norvegicus* (Erxleben).—Mr. Thomas (P. Z. S., 1908, p. 53) reported it from Tsushima. Mr. Orii sent me his observation on the rat on Tsushima as follows:—This rat is found near fresh water and sea shore in great numbers. Its holes were seen in sides of banks and grassy places among rocks. At the ebb-tide, it enters into sea water and captures shells as well as small fishes, etc. It also eats vegetable matter in the fields.

FAM. FELIDÆ

12. *Felis microtis* Milne-Edwards.—One specimen and two skins were presented to me by Messrs. Fukagawa, K. Nakayama and U. Kishihara. I have compared the specimens with one Korean example and found that there is no appreciable difference between them, except the markings are less distinct in the Tsushima specimens. Not common now on Tsushima. Mr. Thomas reported it from this island (P. Z. S., 1908, p. 52).

FAM. MUSTELIDÆ

13. *Mustelaitatsi* Temminck.—A young specimen was obtained by Mr. Teraoka on Iki Island, October 31. Mr. Orii collected specimens on the same island.

14. *Mustela sibirica* Pallas.—A young specimen was presented to me by Mr. C. Kato. It was obtained at Niimura, Tsushima, October 23. Mr. Thomas (P. Z. S., 1908, p. 53) reported it from Tsushima.

15. *Martes melampus tsuensis* (Thomas).—Mr. Fukagawa presented to me a summer skin of this interesting animal. It was obtained at Mine-mura, Tsushima, May, 1919. The head of the specimen is wholly black. Mr. Thomas (Ann. & Mag. N. H. (6), xix, p. 161, 1897; P. Z. S., 1908, p. 52) reported it from Tsushima.

16. *Cervus* (Sika) *nippon nippon* Temminck.—A head with antlers was presented to me by Mr. C. Kato. It was obtained at Niimura, Tsushima, spring of 1919. Another pair of antlers sent me by Mr. N. Yamashita. It was obtained at Tsutsu-mura, Tsushima. Mr. U. Ichimura sent me a skin which was obtained at Tatsurasan, Tsushima. Mr. Thomas (P. Z. S., 1908, p. 54) reported it from the same islands.

The following species are said to have occurred on Tsushima and Iki Islands:

? *Mus molossinus* Temminck.—Mr. Orii informed me that he obtained 3 specimens on Iki Island. They probably belong to this species. Orii's measurements are as follows:

♂ H. & B. 65 mm., tail 59 mm., hind foot 15.5 mm., ear 11.5 mm.

♂ H. & B. 59 mm., tail 55 mm., hind foot 15.0 mm., ear 12.0 mm.

♀ H. & B. 55 mm., tail 52 mm., hind foot 14.5 mm., ear 12.0 mm.

Nyctereutes sp.—Formerly abundant on Iki Island. But at present, it is said that it is almost an extinct species.

Lutra lutra (L.), subsp.—It is said that this animal is found in Tsushima and Iki Islands.

Sus sp.—Formerly abundant (about two hundred years ago) on Tsushima, but now become wholly extinct.

Fukuyoshi Cho, Akasaka, Tokyo, Japan.

ON A NEW BAT FROM MANCHURIA

BY ARTHUR DE CARLE SOWERBY, F. Z. S.

In the autumn of 1914, while on a collecting trip in the forests of North Kirin, Manchuria, on behalf of the United States National Museum, I secured a specimen of a *Murina* representing a form related to *M. huttoni* of northern India, but sufficiently distinct from the latter as well as from all other known forms from eastern Asia to warrant its being separated as a new subspecies of *huttoni*. The specimen was sent to the United States National Museum, where, in company with Mr. Gerrit S. Miller, Jr., of that institution, who passed on his notes to me, I was able to reexamine it. This new form may be known by the name:

Murina huttoni fuscus subsp. nov.

It may be described as a dusky brown form of *huttoni* in which there are numerous long hairs of a lighter color scattered through the pelt and extending on to the webbing between the tail and the hind legs as well as upon the feet. The under parts are slightly lighter than the upper parts.

It differs from true *huttoni* in being of a darker color, *huttoni* having been described as "light snuff-brown" by Hutton in 1872. There is, however, no detailed description of true *huttoni*. Peters described the upper incisors of this species as being separated from the canines as in *suilla*, of Java and Sumatra, his plate of the latter showing a wide and definite space quite unlike the narrow crack in the Kirin specimen.

The Kirin specimen differs from *M. ussuriensis*, Ognev, of the Ussuri region, in its larger size, its forearm measuring 40 mm. instead of 32 mm. It differs from *M. hilgendorfi*, Peters, of Japan, in being larger, its head and body measuring 58 mm. as against 50 mm. There is no sign of the low sagittal crest present in *hilgendorfi*. From *M. auratus*, M.-Edw., of Tibet, it differs in its much greater size; from *M. leucogaster*, M.-Edw. (with which it agrees in general size) in its very different color, *leucogaster* having the entire upper parts "brun-châtain," and in the much less backwardly-projecting occipital region; from *M. sibiricus* in having the upper incisors proportioned as in *leucogaster*; and from *M. rubella*, Thos., in the absence of any red color.

It may be mentioned, incidentally, that *M. ussuriensis* and *M. hilgendorfi* have been secured in Manchuria, while *M. rubella* was described from Kuatun, in Fukien province, China.

Type.—Female, skin and skull, No. 199672, U. S. National Museum, taken in the forest of North Kirin, Imienpo area, Manchuria, September 28, 1914, by A. de C. Sowerby. Original number, 702.

Measurements.—Head and body, 58 mm.; tail, 34 mm.; ear, 18 mm.; forearm, 40 mm. Skull.—Greatest length, 16.8 mm.; zygomatic width, 10.4 mm.; upper tooth row, exclusive of incisors, 5.6 mm.; lower tooth row, 6.4 mm.; lower jaw, 12.2 mm.

Color.—General greyish, or dusky brown, with no sign of reddish. Slightly lighter below, darker round the eyes.

The distribution of this new form is not at present known. Its presence in the Imienpo district so late in September, and the fact that the specimen described above was secured in the house of a Russian peasant, suggest that the species hibernates in this region.

Shanghai, China.

DISPOSITION AND INTELLIGENCE OF THE ORANG-UTAN

BY W. HENRY SHEAK

It is difficult to say which of the two great apes, the chimpanzee or the orang-utan, is the larger. I have spent many years studying living specimens in captivity and the mounted skins and skeletons in museums, but I am not yet convinced in favor of either. It is probable, however, that the chimpanzee will average slightly taller than his Bornean cousin, but there is scarcely any doubt but what the orang will average considerably the heavier of the two. He is much more robust in his build.

I have talked with a number of men who have hunted these two anthropoids, and I have read all the literature available, with a result similar to that from my own personal observations. Doctor Hornaday's largest male of the species *Pongo wurmbii* (if *wurmbii* be a distinct species) measured 4 ft., 6 in. in height. A male of *P. satyrus* measured 4 ft., 4½ in., so that there is very little difference in size between these two. His largest female measured 4 ft. in height. Joseph S. Edwards, the well known exhibitor of rare animals, who has had extensive experience with the orang as well as with the chimpanzee, and who imported the first gorilla that ever reached the United States alive, tells me that his brother once sailed from Singapore with seventeen orangs and two of them were 5 ft. in height. According to Wallace, the stretch of arms of the largest orangs is 7 ft., 8 in. However it has been verbally stated to me that "Chief Utan," the great orang that lived in the Philadelphia zoölogical garden a few years ago and whose well-mounted skin now adorns the mammal hall in the Academy of Natural Sciences of Philadelphia, measured 8 ft., 4 in. from tip of fingers to tip of fingers over the outstretched arms. But I have not had the opportunity of verifying these figures. The weights of the largest adults range from 120 to 160 pounds.

In many of the anatomical characters, the orang-utan does not so much resemble man as does his African relatives of the genus *Pan*. He differs from the chimpanzee in twenty-three characters. In twenty of these the chimpanzee is more like man than the orang, while in but three is the orang more like man than the chimpanzee. These three characters are:

1st. The number of pairs of ribs and number of dorsal vertebræ, there being twelve in the orang, as in man, while in the chimpanzee and gorilla there are thirteen.

2nd. The absence of superciliary crests—prominent bony ridges protruding out over the eyes, which so disfigure the face of the gorilla and are well marked in the chimpanzee.

3rd. The form of the cerebral hemispheres. In the orang they are much more like those of man, than are those of the chimpanzee. The orang has a straight full forehead, while the forehead of the chimpanzee is considerably receding.

In disposition the orang-utan is much quieter and less obtrusive than the chimpanzee. Doctor Hornaday tells me that while he was in their native forests and jungles, he never saw one on the ground, unless he had been wounded or driven down by man. Even when thirsty he does not come to the ground to drink, but climbs out on the limb of a tree overhanging a stream or pool, until his weight bends the branch down so that he may reach the water. In captivity this great ape is much inclined to sit in a corner of his cage, motionless and voiceless. But when captured young he takes fairly well to captivity, becomes friendly and attached to those who feed and care for him, and seems to enjoy human society.

About fifteen years ago I was traveling with the Gus Lambrigger Animal Show as naturalist and lecturer. At the time of which I speak, we had a young orang which had come to us only about three weeks earlier. One afternoon, having finished a lecture, I sat down in a chair with my back to the stage or platform on which the small portable cages were arranged. I was some little distance from the orang's cage. But presently I felt two long hairy arms encircle my neck and a strawberry-blond youngster climbed down into my lap and proceeded to make himself very much at home. He had himself opened his cage door and walked along the stage in front of the other cages until he could climb over on my back.

I have seen the oranges in the New York Zoölogical Park follow their keeper about on the lawn, and when he would attempt to run away from

them, they would hurry after him, using their long arms as a man would use a pair of crutches, but often putting their heads to the ground and turning a somersault in their efforts to overtake their human friend. I have also seen them sit at table and use knife, fork, and spoon in eating, and drink out of an opaque bottle, looking repeatedly down the neck to see how much of the delectable fluid might be left.

A two-year old baby orang which the Edwards Brothers had on exhibition in New York City in 1908, was very timid and much afraid of our large chimpanzee. The chimpanzee liked to tease the little fellow, because she saw he was afraid of her. When she would stamp her foot and threaten him, he would run to me and throw his arms about my neck, plainly imploring my protection from the great black, ugly beast, which he doubtless thought her to be.

Though the orang may sit quietly in a corner of his cage, his beautiful brown eyes see everything about him. Indeed I have found him a very keen observer. One day I was standing in front of the cage of the orang with the Lambrigger Zoo, already referred to, when he came over near me, put his arm out between the bars, and went to examining something on my shoulder. On investigation I found there was a tiny knot, not larger than the head of a small pin, in the thread of the seam in my coat. I had not noticed it previously, but his eyes had caught it from the back of the cage and he was trying to get it.

The orang-utan does not laugh aloud as often as the chimpanzee, but he has a smile that is strikingly human-like. When two young orangs are kept together, they become quite playful, romp and chase each other about, but in a more sedate and deliberate way, and not with the frantic haste and daring so characteristic of the chimpanzee. When thus engaged at play there is often a pronounced and joyous smile on their beaming faces. Now and then there may be a low chuckle, but not often.

As already noted, they often become much attached to their keeper. They are also devoted to their own kind, and will often fight for each other, and especially their young. They will sometimes make pets of other animals, as cats, dogs, and rabbits. I once knew an orang that became much attached to a young pig-tail monkey. They spent much time together, the pig-tail usually sleeping in the ape's arms. The orang was very affectionate, often fondling and caressing his little pet, and showing great patience, for the pig-tail was quarrelsome and vindictive, and often resented the familiarity of his fond foster father.

While the orang-utan is quiet and unobtrusive, and not as good an animal for exhibition purposes as the chimpanzee, I believe him to be almost, if not altogether, as intelligent. He is not always inventing countless new ways of amusing himself and working off a superabundant store of physical and mental energy, as does his African cousin, but when it comes to solving problems to satisfy his own needs or desires, and to doing things that are really worthwhile, he manifests wonderful intellectual power.

A few years ago the Edwards Brothers owned a large orang-utan which they called Joe. He was remarkably intelligent and learned the meaning of about seventy words and expressions. He knew all the coins from the silver dollar down to the copper cent, and would invariably pick out the one asked for. One day the janitor made a mistake in filling a lamp, using gasoline instead of coal oil. When lighted, the lamp, which was directly in front of Joe's cage, took fire all over and exploded, burning Joe severely. After that he was always afraid of a lamp. If he wanted anything, he gave a peculiar call, and then when one of the proprietors or one of his keepers came to the cage, he gave him a push to send him off in the direction of the object desired. One night he had thus called up Solomon Edwards, father of the two Edwards brothers. He kept sending Mr. Edwards off to the back of the room, but nothing the old gentleman brought seemed to satisfy him. Now it chanced there was a lantern, belonging to the watchman, which was hanging in the back of the room, invisible to Mr. Edwards, but where Joe could see it from his cage, and this lantern having been turned too high, was blazing up and smoking. When Mr. Edwards discovered it and turned down the wick, the orang was satisfied. It was plain that he recognized the flame was blazing too high and that he feared another explosion.

On another occasion Joe exhibited what is, to my mind, one of the keenest and most complicated mental processes ever displayed by an animal. On the day in question, there chanced to be an English walnut lying near the cage, but just beyond his reach. He made several ineffectual attempts to secure it by stretching out his long arms. Then he tried to twist some of the straw on the floor of his cage into a rope or wand, but the straw was too brittle and too much broken. It is no uncommon thing for the apes, and even some of the lower monkeys, and especially the spider monkeys, to twist straw into a rope or wand to serve some of their needs. At length the orang began to take off his "sweater," a knit woolen jacket which he was wearing. We wondered

why he was doing this, as he was not in the habit of taking off his clothes without permission. With the slow and deliberate movements so characteristic of this ape, he carefully removed the garment, poked it through the bars of the cage, swung it out till it dropped over the walnut, rolled the nut to within reach, secured it with his hand, then after he had cracked the shell with his teeth and eaten the kernel, he just as deliberately and carefully put the sweater on again.

Joe did not like to take medicine. Mr. Joseph Edwards tried to give him some pills by putting them into the tip end of a banana. But he discovered them in his mouth and picked them out. He looked at the pills, and then he looked at Mr. Edwards, with an expression of reproach and incredulity upon his face, as if he could not believe that his loving master could serve him such a scurvy trick. For a considerable time after that, whenever he was given a banana, he broke off the tip and threw it away or gave it to one of the little monkeys. In his final sickness he was treated by a skilled physician. It was necessary to give him an injection. On the third visit he amazed the man of medicine by getting ready for the treatment just as soon as he saw the syringe. The doctor declared that this was more than he could expect from his human patients.

I have seen the white-handed gibbon (*Hylobates lar*) run and deliberately walk, on the posterior limbs, and as perfectly upright as man. This without any teaching. But aside from the gibbons, the apes rarely do this. When on the ground they swing themselves along by putting down the knuckles and using the long arms as a pair of crutches. However, a big male orang-utan that died in the Philadelphia zoölogical garden in the fall of 1918, was in the habit of doing so. On several occasions I saw him walk about his cage, without using his arms, either on the floor or by holding to a support, and as perfectly erect as a man. Keeper McCrossen declared he had not been taught. This is very difficult for the orang to do, on account of the very imperfect sigmoid flexure of the spinal column.

Philadelphia, Pa.

GENERAL NOTES

A ROVING BAND OF SAY'S BATS

On the 12th day of July, 1912, my little daughter came to say that there were a lot of strange animals in the roof of our porch. I found they were bats, a whole row of them, thirty-two in number, in a long opening under the eaves, heads out, apparently looking at us. All seemed to be the same size, and yet two, which fell down, could scarcely fly. I had to help them up again to the place. These two were undoubtedly *Myotis subulatus*, the long antitragus being very well marked, and I am satisfied that all the rest were of this species. The one I handled uttered a peculiar "chik, chik, chik," while I held it. All dodged back out of sight when I went too close. On the floor below were a number of pellets. These I gathered up and sent to the Biological Survey for examination. That night the bats were very busy around the porch. Next morning all were gone and have never been there since. I have not the slightest reason to suppose that they ever were there before. I do not know of any bat colony in the neighborhood. It seems to me that this incident points to a hitherto unsuspected habit of roaming in bands during the summertime.

The pellets according to report of the Biological Survey "contained the remains of numerous Diptera, several spiders, a scarabæoid beetle and one cuckoo-fly (Hymenoptera) *Chrysis* sp."—ERNEST THOMPSON SETON, *Greenwich, Conn.*

THE BROWN BAT ACTIVE IN WINTER AT WASHINGTON, D. C.

One of our more severe winter days in Washington, D. C., was February 5, 1917. The temperature at noon was 10°F., the atmosphere clear, but the wind high, blustering, and penetrating. At 1:25 p.m. I noticed a brown bat (*Eptesicus fuscus fuscus*) flying past a window at the west end of the new National Museum. It alighted on a narrow ledge in a cornice, 9 feet above ground, on the north wall of the extreme west wing (freight entrance) of the museum. Here it was exposed to the full blast of the cold wind from which it was apparently suffering intensely. It would remain still a moment, hunched up with the wing membrane protecting its side. Then it would run along the ledge 2 or 3 feet and rest again. These actions continued for about 8 minutes, when it flew to the ground and alighted on a cement sidewalk about 20 feet from its former resting place on the wall. A few minutes later I rescued it from the pavement. It was now in a semi-dormant condition, showed none of its bat-like pugnacity, and evidently would have died soon from exposure. I brought it into the museum where the warmth almost instantly revived it. Released, it flew about the office for about 5 minutes, frequently testing the wall for a favorable place to alight. It finally settled at the edge of the ceiling where it hung by its pollical claw from a crack between the ceiling and wall.

While the bat was flying about the room, its form, outlined against the white walls, tempted me to count the wing beats. I was surprised that, in several counts, they averaged 280 per minute.—HARTLEY H. T. JACKSON, *U. S. Biological Survey, Washington, D. C.*

THE GRIZZLY BEAR AS A TREE-CLIMBER

We are all, of course, familiar with the ever recurring statement that the full grown grizzly does not climb, and William T. Hornaday in his *American Natural History* claims that this species, in contrast to the agile black bear, cannot climb trees.

At the present time there is confined in the Philadelphia Zoological Gardens, a fully matured grizzly (*Ursus horribilis*) which, whenever occasion arises, both climbs and descends the tree in the center of his den with far greater speed and ease than any black bear ever exhibited, and I have personally observed other grizzlies confined in the same dens demonstrate similar climbing ability.

Is it not, therefore, reasonable to suppose that grizzlies have the ability to climb, but that their habits of life are such that, under normal conditions, climbing would never be a useful trait to develop?—ARTHUR H. FISHER, *Washington, D. C.*

WOLVERENE IN ITASCA COUNTY, MINNESOTA

In a recent paper on the mammals of Itasca County, Minnesota, there appears no record of the wolverene (*Gulo luscus*) for the region. (Cahn, A. R., *Journ. Mamm.*, vol. 2, pp. 68-74, May, 1921.) Through the kindness of Dr. H. V. Ogden, of Milwaukee, Wisconsin, there has been for several years an almost perfect skull of an adult male wolverene from Minnesota in the possession of the Biological Survey. The animal was killed in section 7, T 61 N, R 25 W, Itasca County, January 11, 1899. The specimen is number 110,281, United States National Museum, Biological Survey Collection.—HARTLEY H. T. JACKSON, *U. S. Biological Survey, Washington, D. C.*

MORE ACROBATIC SKUNKS

During 1912 I published in *Country Life* an account of my skunk farm. A paragraph was devoted to the skunk "Johnny Jumpup" who had the curious trick of standing on his front feet with hind feet up in the air. Commenting on this in a letter, Mr. J. S. Duss, Jr., of New Smyrna, Florida, wrote to me at the time that "civet cats" were quite numerous around his house on the peninsula opposite the town. They were very tame and it was almost the rule for them to do the "very stunt which Johnny does." He had seen "several at one time about the back porch doing the act."—ERNEST THOMPSON SETON, *Greenwich, Conn.*

RED SQUIRRELS SWIMMING A LAKE

On September 18, 1921, I visited White Sand Lake, Vilas County, Wisconsin, on a fishing trip. While my companion and I were arranging for a boat he noticed a small animal swimming some distance out from the shore and asked what it was. I ventured the opinion it might be a muskrat, but the boatman said no, it was a red squirrel, and that they had been crossing the lake to this (the south) shore from a point on the north shore for some days past. Sometimes as many as four or five were seen to cross in one day, according to his statement. I was somewhat incredulous as I had never seen a squirrel take voluntarily to the water. His assertion in this case was soon verified, however, for the little animal came almost directly toward us and landed scarcely twenty feet from where we were standing. It didn't hesitate a moment as it reached the land but quickly crossed

the narrow beach and plunged into the underbrush. Its landing apparently excited the interest or curiosity of another squirrel, which came chattering down a nearby tree. It would have been easy to interpret the incident as the cordial greeting of a relative who had made the passage earlier and was anxiously awaiting the arrival of the recent immigrant.

The point from which the squirrel came is a long, heavily wooded promontory extending from the north shore, and separated from the south shore by perhaps an eighth of a mile of open water. At other places the lake is the better part of a mile in width. No reason for the migration—for the transit of the lake seemed to be in one direction only—was evident, though the boatman suggested that "something must be after 'em over there." Perhaps a more plausible explanation is that there was a scarcity of food on the point (or a superabundance of squirrels, which would amount to the same thing) which was driving them to seek new territory and the heavy forests of the south shore were more attractive than the somewhat more scanty growth to the northward.

The individual we saw swam calmly and evenly with head well up, shoulders nearly submerged, but rump and tail high. It gave the appearance of swimming without exertion, and did not seem at all fatigued when it reached the land. It may be a common habit for squirrels to cross bodies of water in this way, as it is with many other land mammals, but if so, it has escaped my notice.

Since writing the above note I have learned from a colleague, Prof. William H. Wright, that on August 15, 1921, he caught a "pickerel" (great northern pike, *Lucius lucius*) 37 inches in length and weighing a little over 11 pounds, which contained in its stomach a full grown red squirrel. The squirrel was intact, having apparently been devoured quite recently. The fish was caught in Lake Fanny Hoe, Keweenaw County, Michigan, at about 7 p.m. This is a deep lake some two miles long and one-fourth to one-half mile wide, and is completely surrounded by forests. The residents of the region expressed no surprise as they said the squirrels frequently swim the lake.—LEON J. COLE, *Madison, Wis.*

GRAY SQUIRREL IN THE ADIRONDACKS

In 1887 I was shooting on the south branch of the Beaver River in the Adirondacks. At that time red squirrels were very numerous, but one day, on the edge of a burning among some bushes, I saw a gray squirrel which I shot. It was an adult male and besides being castrated had only the stump of a tail and showed many scars, the result I suppose of attacks by red squirrels. As this was the only gray squirrel I ever saw in that part of the country, and I was there in 1887, 1888, 1889, and 1890, I write to ask if there are other records of them. My guides had never seen others there.—GEORGE L. HARRISON, *Poplar House, St. Davids', Pennsylvania.*

EARLY RECORDS OF BUFFALO IN "CALIFORNIA" [= NEVADA, UTAH AND SOUTHWESTERN WYOMING]

Several early writers mention the buffalo as a native of California. Thus Lansford W. Hastings, in an account of an overland trip to Oregon and California in 1842, enumerates the game found in what was then the western part of California—the California of today—and states that the game in the *eastern section*—now Nevada, Utah, and western Wyoming—was with very few exceptions

practically the same. He goes on to say: "In addition, however, to the game found in that [*western*] section, the white bear [= grizzly], the mountain sheep and the buffalo, are also found, in this [*eastern*] section. The latter of which, are here found in much greater numbers, than in any other portion of the country, west of the Rocky Mountains. In many portions of the country, the plains and hills are literally covered with them. Several tribes of the Indians here, as in Oregon, subsist almost entirely upon the beef of the buffalo, which they are enabled to obtain, in any desired quantities."¹

This reference to buffalo and grizzly bears in California requires explanation. At the period in question (1843) California was a Mexican province extending easterly from the Pacific Coast to the Rocky Mountains. Hastings states specifically that Green River "is to California what the Columbia is to Oregon, the Mississippi to the United States" and so on (p. 72). He states also: "The Colorado and its tributaries water much of the northern portion; most of the southern, and all the eastern portion of Upper California" (p. 75); and furthermore that Great Salt Lake is "situated entirely in California" (p. 76). This accounts for the mention of buffalo in connection with grizzly bears and mountain sheep in California.

Chittenden's Map of the "Trans-Mississippi Territory"² during the period of the Fur Trade from 1807 to 1843 places the northeastern boundary of the Mexican Possessions far enough east to include not only the Green River country but also the Medicine Bow Mountains of Wyoming.—C. HART MERRIAM, *Washington, D. C.*

¹ Lansford W. Hastings, *The Emigrants' Guide to Oregon and California*, p. 99, 1845.

² Hiram Martin Chittenden, *The American Fur Trade of the Far West*, Vol. 3, 1902.

RECENT LITERATURE

Cabot, William Brooks. LABRADOR. Boston; Small, Maynard & Co. 8 vo., xiii + 354 pp., illustr., 1921.

A land of great spaces, of windswept hills and strong rivers, of uncounted lakes and uncharted coasts, Labrador is today the only remaining wilderness in eastern North America. That it has been so little visited is due in part to its forbidding aspect, the difficulty of transport, the almost unbelievable multitudes of mosquitoes, conditions which combine to repel the casual traveler. For these very reasons it continues to be the home of a tribe of splendid Indians, the Naskapi, who live their primitive hunter life little touched by the all-destroying white man.

The author tells of a series of summer excursions mainly into the more northern portion along the east coast of the peninsula, partly with a view to geographical work, largely, however, for the study of these same Indians into whose favor he has patiently won his way.

Though chiefly concerned with other things, the book contains many valuable notes on mammals. In especial, the chapter devoted to "Mice" should become a classic to stand with Darwin's bumblebees. The species is apparently the Labrador meadow mouse (*Microtus enixus*). "Like the rabbit it increases in numbers through a term of years and suddenly disappears. . . . In 1903, my first year in the country, mice were not noticeably plenty. Caribou had been abundant through the winter, by early July passing north in large numbers close to the coast. There were some falcons about, the splendid light-colored gyrfalcons, besides rough-legged hawks, dark and almost equally fierce. Both kinds breed in cliffs about the islands. I saw few ptarmigan. . . . Foxes, the most important fur game, were fairly plenty. By 1904 mice were distinctly abundant. Hawks were more numerous, the white ones shrilling from many cliffs as we approached their nests. It was that year, I think, perhaps the next, that foxes were noted by the shore people as being scattered and shy; they would not take bait. . . . Ptarmigan were fairly numerous. The wolverene we shot was full of mice. There were no caribou to speak of. We saw a good many wolf tracks, chiefly along the river banks, where mice are apt to be, but heard no wolves at night. . . . The next year, 1905, was the culminating year of the mice. Sometimes two at a time could be seen in the daylight. Low twigs and all small growth were riddled by them. There was a tattered aspect about the moss and ground in many places not quite pleasant to see. . . . Falcons had increased visibly. . . . Owls were not many, but had increased somewhat; we saw only one snowy owl. All trout of more than half a pound had mice inside. Ptarmigan were very plenty, and the wolves—we may have seen the tracks of two hundred—were silent still. The bear of the trip was full of mice. . . . Caribou were still scarce even on George River, and foxes plenty. In the spring of 1906 the mice disappeared with the snow. . . . With the vanishing of the mice the change in the visible life of the country was remarkable. The falcon cliffs were deserted, coast and inland. . . . We felt the absence of their superb flights and cries. In the trout reaches of the Assiwaban fish were numerous, but they were living on flies now, with what minnows they could get, and were no longer mousey but sweet and good. No owls appeared;

there had, however, never been very many. Our bear of the year was living on berries. . . . Ptarmigan were all but wanting, old birds and young. It is fair to suppose that in previous years they were let alone by their natural enemies in the presence of the superabundant mouse supply, and were enabled to increase to their unusual number in 1905. . . . For the first time we heard the wolves nights, a far, high-pitched howl—their hunting cry. I suppose it is for the ears of the caribou. Uneasy, they move, a track is left for the wolf to find and sooner or later the chase is on. . . . Once the wolves found themselves upon the hard times of early 1906 they may have sought the caribou and started them to move. They certainly did move, as the twelve or fifteen hundred carcasses [killed by the Indians for winter use] at Mistinipi that year went to show.

"The bearing of the mouse situation on the human interests of the region is easy to see. It affected all the game, food game and fur. The abundance of mice tended to build up the ptarmigan, which are of vital importance in the winter living of the Indians through the whole forested area to the Gulf. Likewise it built up the caribou herd by providing easier game than they for the wolves. The departure of the mice did the reverse, reducing the deer and ptarmigan, but it may have brought the deer migration as suggested. . . . Nor were the shore people by any means untouched. All their land game came and went, was plenty or wanting, shy or easily taken, according to the supply of mice. London and St. Petersburg, easily, were affected through their great fur trade." These and other relations in the interdependence of animals are forcefully suggested.

Under the heading "Creature Colorations" are gathered a number of keen observations as to the adaptive significance of the color pattern of certain northern species, including the wolverene, the arctic and varying hares, weasels and ptarmigan. These and numerous other items told in passing constitute all together a valuable contribution to the natural history of the North.

The book itself is attractive to the eye and hand; its story of travel, hardship, and discovery is well and simply told, intimate yet restrained. The spirit of out-doors runs through it all; one comes regretfully to the last page.

—Glover M. Allen.

Thorburn, Archibald. *BRITISH MAMMALS*. Longmans, Green, and Co., London. 4 to, Vol. 1, pp. i-viii, 1-84; col. pl. 1-25, line cuts in text, 8. 1920. Vol. 2, pp. i-vii, pp. 1-108; col. pl. 26-50, line cuts in text, 8. 1921.

The purpose of this splendid work as set forth in the preface "has been to provide pictures in colour of all those animals classed as mammals which inhabit or visit our islands." The author includes in this scope the Cetacea, twenty forms in number, making the treatment very comprehensive.

To quote again from the preface: "Planned as a companion to the volumes on 'British Birds' and 'A Naturalist's Sketch Book,' recently published, it gives a series of reproductions from water-colour drawings of the seventy species which make up the list, and in addition to these are shown various subspecies or closely allied forms, among others some of the local races of mice which have attracted the attention of naturalists during recent years." "A short description of the animals represented has been included, giving the general distribution, colour, measurements, and some notes on the habits of the various species,"

The two volumes comprise a de luxe edition of beautiful and artistic colour plates with accompanying text, the treatment being designed more for the layman than for the systematic worker. Scientific names are given for all of the groups, from the order to the subspecies, although the trinomial is seldom employed, while the common name is given the emphasis. The characters of each species, brought out in the text, are generally few and of such a nature as to be most readily discerned by the layman.

The first volume takes up the Chiroptera and deals with twelve species, all of which are figured in the coloured plates. The greater horse-shoe bat is given some four pages of text, which serve as a preparation for the treatment of the order, but most of the other species are given less space. Accounts of habits, food and distribution make up the bulk of the text.

The order Insectivora includes only five species, the hedgehog, mole, and three species of shrews. All five are portrayed in colour with a text treatment similar to that given to the bats. Fifteen species are taken up in the Carnivora, beginning with the wild cat and fox, including the walrus and six species of seals and concluding with the Mustelidæ, the otter, badger, pine martin, polecat, stoat and weasel. Fourteen plates are given to this order and among these plates are some of the most effective of the two volumes. The text treatment seldom runs up to three pages, even the fox being allotted only a scant two and a half pages, while some of the seals are dismissed with a page.

The first volume closes with two species of the Rodentia, the common squirrel and the common dormouse, each being given a plate. In the second volume this order is completed, with a total of nineteen species and in addition to the two plates of rodents in the first volume, eleven more are devoted to the order in this volume. Incidentally the author uses the blanket name *Mus* to cover nine of the small rodents, taking under this genus the harvest mouse, wood mouse, common mouse and brown rat. The text accompaniment varies from three and a half pages for the harvest mouse and the common hare to a scant page for the Orkney vole. The Ruminantia, with four species claim five plates and twenty pages of text.

The second volume takes up the last order, the Cetacea, with twenty-one species, nine plates and forty-six pages of text. The treatment of the order begins with four pages of remarks on the order in general, dealing with points of structure, measurements, food habits, classification, etc. The volume concludes with a few paragraphs upon mammals which have become extinct in the British Islands within historic times, the wolf, brown bear, beaver, reindeer and wild boar. An appendix gives additional data on the validity of the record of the occurrence of the walrus in the British mammalia. An index of four pages gives references under both scientific and common names.

The volumes are very well gotten up, the paper is very heavy and the type large, the plates are upon the highest quality stock and in the arrangement throughout the artistic influence of the author is readily apparent. The text is largely compilation from other authors with no attempt at the introduction of original matter, its sole function apparently being to serve as the medium for a satisfactory interpretation of the author's pleasing portrayals.

—H. E. Anthony.

Macewen, William, *THE GROWTH AND SHEDDING OF THE ANTLER OF THE DEER. THE HISTOLOGICAL PHENOMENA AND THEIR RELATION TO THE GROWTH OF BONE.* Glasgow: Maclehose, Jackson & Co., publishers to the University. Pp. i-xvii, 1-109, with 109 half-tone figures. 1920.

This beautifully illustrated volume is of as great value to the anatomist as to any one interested in deer. For the first time we have an anatomical treatise on the growth and shedding of the deciduous antler of the deer. This important investigation deals in detail with the histological changes which take place in the growing antler; it adds much to our understanding of the process of shedding of the antlers and explains their phenomenal growth.

Nowhere among animals do we find such an enormous and rapid reproduction of all the elements of the skin as in the growing velvet of the deer, which may cover the largest palmate antler within three months. The blood vessels in the velvet, which also form in a surprisingly short time, maintain the temperature of the growing bone within the hairy covering. These vessels anastomose but little with those of the underlying bone. The osseous growth of the antler is so rapid that the different phases of bone development may occur coincidentally. From the very beginning of antler formation there is going on a preparation for shedding. The latter is caused by the constricting of the blood vessels within the antler, particularly at the base, through the rapid proliferation of the bony tissue around them, which is followed by necrosis. Prior to the shedding, the bone on the distal end of the pedicle becomes softened, blood vessels within the pedicle increase in number and size, and granulation tissue is formed which loosens the connection between the dead antler and the pedicle. The shedding of the velvet, which precedes that of the antler, is likewise provided for in early stages of its growth. The bony substance emanating from the pedicle overlaps the latter, even in the sprouting antler, and forms the corona. The corona sends at first bony projections between the blood vessels of the velvet, which thus lie well protected in grooves. Gradually, however, these vessels are compressed and ultimately strangled by the advancement of ossification in the corona. The whole cutis then dries and peels off. The abundant multiplication of the bony cells in the growing antler, which are derived from the osteoblasts in the pedicle, can hardly be explained by normal cell division alone. The process known as nuclear budding may also partly account for this rapid production in ossification. During the growing period the antler is capable of repair after injury; at this time the pedicle is full of blood, which it transmits to the interior of the antler. After the termination of its development, the antler, no doubt, dies. The pedicle, however, must at all times be in active life, and preparing for the production of a new antler immediately after the shedding of the old one.

In addition to these normal conditions, the effect of injury to and disease of the pedicle and of castration on the growth of antlers is discussed in this much needed book.

—A. H. Schultz.

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distinguished: (1) Vertical stripes on the trunk, circular ones on the extremities, and stripes forming acute angles in the regions where those of the trunk and extremities meet and on the forehead and cheeks, e.g. Grèvy zebra. (2) Longitudinal stripes on the trunk, as in some young wild swine and in tapirs. This is a primitive type and is frequently found in combination with type 1. (3) Vertical stripes of the trunk extending to the extremities, which have no circular stripes. This type is restricted to some domesticated animals and never occurs in wild forms. The arrangement of stripes varies greatly within the same species and even in the two halves of the body. The author attempts to correlate the stripes with the folds in the skin at various stages of growth. The arrangement and direction of skin folds in the new-born rabbit, for instance, resembles closely the stripes of type 1.

—A. H. Schultz.

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THE WHITE-TAILED DEER OF EASTERN UNITED STATES

BY THOMAS BARBOUR AND GLOVER M. ALLEN

[Plates 4-5]

Naturalists and sportsmen long ago remarked the large size of adult white-tailed deer of New England as contrasted with the appearance of deer from the South Atlantic States. Baird (1857) compared specimens from New York with those from Virginia and South Carolina, pointing out that the latter seemed to average smaller. Following him, Dr. J. A. Allen (1871) briefly remarked the same contrast between the deer of the northeastern states and those of Florida. Cory (1896) in his *Hunting and Fishing in Florida* devotes a brief chapter to deer, and makes the more definite statement that "the Florida Deer is smaller and varies slightly in color from the true *C. virginianus*. A full-grown buck will often not weigh over 110 pounds, although I have killed them considerably larger, and probably they occasionally (though rarely) approach in size their Northern relation." Dr. C. Hart Merriam in his *Mammals of the Adirondacks* (1884, p. 4) says, "Our deer are much larger than those of the South and Southwest, adult well-conditioned bucks averaging from 200 to 225 lbs. avoirdupois in weight, and exceptionally large ones being much heavier. Hence the Adirondack Deer is more than double the size and weight of the same species in Florida." In a brief and unsigned review of Cory's book, Dr. Elliott Coues (in *The Nation*, vol. 62, p. 404, 1896) emphasizes the difference in size between the northern representatives of certain species and those occurring in Florida, and casually proposes two new names, one for the Florida red bat (*Atalapha borealis peninsularis*) and one for the Florida deer (*Cariacus fraterculus*). Both names are *nomina nuda* and furthermore the two forms in question had been described and

named shortly before, the bat by Rhoads, the deer in a preliminary paper by Mr. Outram Bangs (1896) who at that time was energetically investigating the mammalian fauna of Florida preparatory to the publication (in 1898) of his summary of the species known from the state. In naming the Florida deer *Cariacus osceola*, he unfortunately lacked specimens of typical *virginianus* for comparison, but contrasted the deer of northern Florida with the large deer of Maine which at that time was believed identical with typical *virginianus*, but was later named by Miller (1900) as a distinct race, *borealis* (type from Bucksport, Maine).

Although it was originally thought that the Florida deer differed so markedly from typical *virginianus* as to constitute even a distinct species, the gradual accumulation of additional facts and specimens in the intervening years has shown that the supposed sharp distinctions were after all of only relative value, until it became finally a question whether or not the deer of Florida were really distinct from true *virginianus* with which as yet it had not been carefully compared.

With these facts in mind one of us (Barbour) has spent no little time and effort during the course of several visits to Florida, in gathering notes and material, particularly skulls, that might throw light on the relationships of the white-tailed deer of the peninsula. Such great changes are now taking place in the way of clearing large areas of woodland, building railroads, and constructing drainage canals in Florida that the distribution and abundance of so large an animal as the white-tailed deer cannot but be changed very considerably within a few decades. The importance of obtaining adequate material to illustrate its present distribution is, therefore, obvious.

In the course of our work it at once became clear that an adequate idea of the characters of typical *virginianus* was essential, and this made necessary a re-examination of the status of the northern race *borealis*. Of Florida specimens, in addition to three of the original four representing Bangs's *osceola*, the Museum of Comparative Zoölogy now has a series of skulls from Cumberland Island, Georgia, a series from the vicinity of Palm Beach, Florida, and a third lot from Chokoloskee in extreme southwestern Florida; as well as a few from other localities in northern Florida and three others from Big Pine Key, some 130 miles south of Miami. Years ago by permission of the New York authorities Barbour was able to obtain specimens in summer coat from the Adirondacks, which with the type and other specimens in the Museum of Comparative Zoölogy fairly represent the northern race *borealis*.

Thanks are due the U. S. National Museum and the Biological Survey for the loan of skins and skulls to supplement the few in the Museum representing typical *virginianus*; also to Maj. Allan Brooks for additional notes and sketches from Florida.

The material now before us, though still inadequate, embraces a fairly considerable series of skulls from eastern North America, together with skins representing winter and summer pelages of both sexes. A study of these specimens seems to indicate that occasionally deer may attain as large a size in northern and east-central Florida as in Virginia or Maine and that there is no natural discontinuity in the general distribution of the species from north to south on the mainland. The northernmost deer have been considered as representing a large subspecies with longer tooth rows and bigger antlers, but in dimensions adult Maine skulls can be matched by those from Palm Beach, Florida. It is further apparent that the northern race *borealis* (type locality Bucksport, Maine) is at best a poorly marked subspecies characterized perhaps by its more widely spreading antlers, much longer winter coat, and slightly brighter color in summer. The deer of the extreme southern tip of Florida on the other hand is very small indeed, with a small skull and small delicate antlers, yet with a tooth row very little reduced in absolute size from that found in typical *virginianus*. To this we propose to restrict the name *osceola*, considering the type, and other specimens from Citrus County, to be extreme intergrades, and standing really nearer to true *virginianus* than to the small deer from the tip of the peninsula. Finally, we are describing as a very distinct geographic race the small pallid deer with reduced tooth row that inhabits the southernmost keys of Florida. These four races of the eastern United States may be characterized as follows:

Odocoileus virginianus virginianus (Zimmermann)

VIRGINIA DEER

Dama virginiana ZIMM., Specimen Zoologicae Geographicae, p. 351, 1777.

Type.—Based on Pennant's Synopsis, 1771, p. 51, pl. 9, fig. 2 (antlers).

Type locality.—None specified beyond "America," though assumed to be Virginia; but the references are to Lawson's and Catesby's works on Carolina.

Diagnosis.—Adults nearly or quite equalling in size the race *borealis*. Color of summer and winter pelages markedly different; in summer the coat is bright, nearly uniform ochraceous buff on dorsal surfaces of neck, body and legs; in the winter pelage the hairs of the back are black-tipped with a narrow subterminal band of pale ochraceous giving a much darker, ticked appearance. Upper cheek teeth 73-81 mm.

Description.—A fawn (2395 M. C. Z., from Citronelle, Florida, August 4, 1894) is nearly uniform "ochraceous buff" on the head and body above, paling to "warm buff" on the limbs and sides of neck and body; body spotted with white in a definite pattern: a line of spots on each side of spine from occiput to root of tail, succeeded by four or five less regular broken lines of spots on the sides from fore shoulder to haunch. Black bases of long hairs of tail showing through at the edges.

An adult male in summer (108038 U. S. Biol. Surv., July 17, 1894, Citronelle, Florida, taken as representing the extreme southern *virginianus*) has the forehead, neck all around, body and limbs above ochraceous buff, slightly warmer on forelegs, the center of back slightly darkened by showing through of a dark brownish band occupying about the middle third of each hair; sides and tip of tail above blackish with white fringe of long hairs from under side; ears dusky.

Adult in winter much darker, the crown, neck all around, and the body, a finely grizzled mixture of pale ochraceous buff and dusky—nearly "sepia,"—each hair with a fine blackish tip, a narrow subterminal ring of pale ochraceous and then a long dusky portion, paling out toward the base. Short hair on cheeks and muzzle similar but the pale band nearly grayish. Younger animals have the ochraceous buff less intense. A female from South Carolina, probably a yearling, has the pale annulus nearly "light buff", clearer on the legs but on the body much subordinated, producing a very dusky appearance with a clear dusky median stripe extending over the upper surface of the back and tail.

Skull.—Adult skulls equal in size those of average *borealis*, nor are the tooth rows inferior in length. The antlers of the average adult male have, as is well known, an inner tine a short distance above the burr, and three others on the upper side of the beam, the most proximal of which is usually the longest. Occasional especially vigorous adults have additional tines which may be irregularly developed. The basal portion of the antler from the burr to the first tine is on the average set at only a slight angle to the long axis of the skull, so that the line from burr to tip of basal tine tends to be more or less parallel to that axis and results in giving the tips of the beams in adults a tendency to approximate each other more or less closely. Nevertheless, this is not invariable, and occasional heads of southern deer have the antlers depressed and as wide-spreading as those in the North.

Weight.—Reliable weight-records for typical Virginia deer are not readily available. Cory (1912, p. 62) writing of the deer in Florida, states that though full-grown bucks often weigh not over 110 pounds, "these, however, are smaller than the average, and I have killed at least one specimen in southern Florida which weighed more than 200 pounds. . . . For many years I carried steelyards with me in the field for the purpose of weighing large game. One buck weighed 204 pounds and during a dozen years I have killed others which . . . were fully as large." A hunter who has killed many deer in Volusia County, Florida, assures us that the deer in Palm Beach County, to the south, where he has hunted of late years, average some thirty pounds less, indicating probably a gradual diminution in bulk as one proceeds southward.

Remarks.—Some difficulty has been experienced in determining the color characters of the typical Virginia deer, for lack of summer skins from near the type locality. While the limited material at hand seems to indicate that the

northern deer are slightly more tawny in summer without the darkening of black-ticked hair on the back, it may prove on examination of larger series that the difference is less than supposed.

In regard to the use of the specific name *virginianus* of Zimmermann instead of *americanus* credited to Erxleben (1777), it seems perfectly clear that the latter did not intend his adjectival use of *americanus* as a new name; nor does it occur in the same typographical form as the new names proposed in the same work (see J. A. Allen, 1900, p. 318; 1902, pp. 15, 18; W. H. Osgood, 1902, p. 87; O. Thomas, 1913, p. 585, footnote). Pennant, in his brief account of the "Virginian Deer," (the basis of Zimmermann's name) refers to Lawson's and Catesby's accounts of the natural history of the Carolinas, and quotes Ray's *Dama virginiana*, which no doubt was adopted by Zimmermann in turn. His figure of the antlers is unmistakable, though portions of his text seem to refer rather to the caribou.

Specimens examined:

MARYLAND: Cumberland, 3 (skulls).

VIRGINIA: No locality, 1 (skull); Appomattox River, 1 (skull); Claremont, 1 (skull); Highland County, 1 (skull); Hot Springs, 1 (skull); Richmond, 1 (skull); Rowleysburg, 1 (skull); Winchester, 1 (skull).

WEST VIRGINIA: Meadow Creek Mountain, 1 (skull).

NORTH CAROLINA: Halifax, 1 (skull); Halifax County, 1 (skull).

SOUTH CAROLINA: Colleton County, 2 (skulls); Georgetown, 1 (skin); Green Pond, 1 (skull).

GEORGIA: Cumberland Island, 7 (skulls).

ALABAMA: Mount Vernon Barracks, 1 (skull); Orange Beach, 1 (skull); Tensaw River, 1 (skull).

FLORIDA: Eastern Florida, 1 (skull); Big Cypress 25 miles southeast of Lake Trafford, 1 (skull); Brevard County, Kissimmee Prairie, 3 (skulls); New Smyrna, 1 (skull); Palm Beach et vic., 6 (skulls, one with headskin) and 3 pairs of antlers with frontlets; Sebastian, 1 (skull).

KENTUCKY: Big Bone Lick, shed antler.

Odocoileus virginianus borealis Miller

NORTHERN VIRGINIA DEER

Odocoileus americanus borealis MILLER, Bull. N. Y. State Mus., vol. 38, p. 83, October, 1900.

Type.—Adult male, skin and skull, 4999 Mus. Comp. Zool. (Bangs Coll.), from Bucksport, Maine, December 12, 1895.

Diagnosis: Similar to typical *virginianus* but summer pelage redder, the feet usually with conspicuous fringe of white hair between the toes; size on the average a very little larger; antlers usually coming off from forehead at a greater angle giving a slightly flatter spread, with less tendency for the tips of the beams to converge. Upper cheek teeth average 83 mm.

Color.—A fawn in full spotted coat (14913 M. C. Z. from Tupper Lake, Adirondacks, New York, August 25) is clear "tawny" on the upper neck, back and dorsal surface of tail, paling to a light "cinnamon" on ventral surface of neck, on the limbs and lateral line; ears mixed grayish externally. It is much more

tawny than a perfectly comparable *virginianus* fawn. The lines of white spots as in the typical race.

Adult *in summer*, (14921 M. C. Z., ♀, from Tupper Lake, New York, August 24) uniform tawny above from crown to tail without intermixture of dark-tipped hairs, paling at the sides, on limbs and front of neck to cinnamon; sides of muzzle pale grayish, the backs of the ears and a median line on the muzzle dusky. A conspicuous fringe of white hair between the toes of both fore and hind feet.

Adult *in winter* (4999, type, ♂, from Bucksport, Maine, December 12) identical with typical *virginianus* in corresponding season, but with the pelage longer than in deer from the extreme south of its range, and with a conspicuous fringe of white hair between the toes.

Skull.—We have been unable to discover any characters that will uniformly separate skulls of northern deer from those of Maryland, Virginia, Georgia, northern and central Florida. While skulls from the north tend to be large, they can be closely matched in the series from Palm Beach, Florida. In adult males, however, it is much more usual to find the basal portion of the antler coming off at a wider angle, so that not only does the basal tine often point in or form a wide angle with the main beam (instead of nearly continuing its basal axis) but as a result the beams are more spreading and seldom have their tips so closely approximated as in well developed heads of *virginianus*. The skull of the type of *borealis* is unusually large and the antlers more spreading than in the average deer from the North.

Measurements.—See table (p. 76).

Remarks.—In the brief diagnosis of this northern race (Miller, 1900) true *virginianus* is distinguished by its relatively small teeth ("lower row of cheek teeth 75" mm.) and by having the "winter pelage not conspicuously grayer or coarser than summer pelage;" whereas *borealis* has relatively large teeth ("lower row of cheek teeth 85" mm.) and the winter pelage is "coarse, usually much tinged with gray, very different from summer pelage." The material now available shows that these criteria do not all hold good.

Phillips (1920, p. 132) has lately shown that in 95 adult males from Maine the lower tooth row averages 83 mm. with extremes from 71 to 92. In an adult male from Winchester, Virginia, before us, the lower tooth row is 88, in two others from Virginia, 77 and 81 respectively, and in five adult males from Palm Beach, Florida, 78, 80, 85, 86, 87 respectively. There is probably a very slight average difference between extremes of the two races, but it is hardly diagnostic. As to the supposed lack of a seasonal change in color in the case of the southern deer, it is difficult to see on what ground the supposition rested. For while the adult in summer from northern Florida may not be quite as clear or bright a tawny as an Adirondack deer "in the red" it is quite as obviously different in its close ochraceous pelage of this season from the longer, more mixed "blue" or "gray" of its winter coat. So far as the scant material at hand indicates there is no color difference in winter coats of *virginianus* and *borealis*, except that in Florida one never sees a deer with such a long, shaggy "gray" coat as is assumed, for instance, by Adirondack deer in mid-winter; but the summer coat of the latter in both fawn and adult is apparently a trifle brighter, a clear tawny rather than ochraceous-buff with dark ticking, though how far this will hold true in a larger series is not yet certain. Another striking difference between the northern skins and

the southern ones available for comparison is that the former have a conspicuous white fringe between the toes, lacking in most southern specimens.

Where *borealis* intergrades with *virginianus* and where the southern border of its range may be traced are still matters for further investigation. Probably in the range of *borealis* should be included all of New England and at least northern New York, west to Ontario, northern Wisconsin and Minnesota (Cory, 1912). Whether the deer originally indigenous to southern Connecticut and those of southern New York (Long Island) are better referred to *virginianus* we are not prepared to say. Rhoads considers the larger deer of Pennsylvania *borealis*. Skulls from Maryland, Virginia, West Virginia, the Carolinas, Georgia, Alabama, and northern and east-central Florida are certainly to be considered typical of *virginianus*. The westward limits of both forms and the exact status of the races *macrourus* and *louisianæ* are still matters requiring further study.

Weight.—Large deer in winter coat will generally weigh over 200 lbs., and exceptional individuals considerably exceed this.

Specimens examined.—

MASSACHUSETTS: Lee, 1 (skull).

MAINE: Locality indefinite, 3 (skulls); vicinity of Upton, 33 (skulls); Bucksport, 4 (2 skins and skulls including type).

NEW YORK: Big Tupper Lake, 11 (including 6 skins with skulls).

ONTARIO: 2 (skulls).

Odocoileus virginianus osceola (Bangs)

FLORIDA DEER

Cariacus osceola BANGS, Proc. Biol. Soc. Washington, vol. 10, p. 26, February, 1896.

Type.—A young adult female, skin and skull 2394 M. C. Z. (Bangs Coll.) from Citronelle, Citrus County, Florida, December 29, 1893.

Diagnosis.—In its extreme form, slightly smaller in cranial dimensions, but with tooth rows practically as long as in *virginianus*; general bulk of body considerably less, the antlers much reduced in size; upper cheek teeth 72–77 mm.

Remarks.—In describing the small deer of Florida as a distinct race, Mr. Bangs had unfortunately no specimens from the type locality of *virginianus* for comparison. Of his original series two, including the type, are females decidedly undersized, one of them indeed abnormal in wholly lacking the third upper molar on the right side while the corresponding one on the left side lacks the hypocone, so that the tooth is triangular in outline rather than quadrilateral. The two adult males of the series on the other hand, one from Citronelle, the other from Blitche's Ferry, Citrus County, are good-sized animals, fully as large as typical *virginianus* from farther north. Indeed, it would be perfectly fair to consider the entire series as representing *virginianus* and to make *osceola* a synonym of it. The series of skulls from Chokoloskee, in extreme southwestern Florida, however, indicates unquestionably a valid race in that part of the peninsula, characterized by its very much reduced antlers, slightly smaller skull, and light weight. For the present, therefore, it seems better to restrict the name *osceola* to these small deer of southern Florida, and to assume in lack of evidence to the contrary that

this form extends northward on the Gulf Coast, intergrading with true *virginianus* in the region of Citrus County and southeastward. Specimens from the type locality would therefore be intergrades, more nearly approaching *virginianus*.

In the six adult males from Chokoloskee, the finest head (pl. 5, fig. 5) has antlers with the beam only 375 mm. long on the outer curve, basal tines 23 mm. long (570 and 85 in a head from southern Maryland), and two additional tines on each beam. Another old animal has two very small points (one broken off) on the right beam, and none on the left. Both beams are thick, with heavy burring at base and directed nearly straight back. The other heads all show a very small delicate beam with basal tines small or in some cases absent entirely, and with at most two short tines additional (pl. 5, figs. 6, 7). Two heads are asymmetrical: one has a simple beam on the right side without tines, while that of the left side has two small prongs; the other head has no basal tines, but two points on the right and one on the left side.

The type of *osceola* is peculiar in having the ascending arm of the intermaxillary widely in contact with the outer tip of the nasal on each side. Almost always, whether in specimens from Florida or from farther north, these two bones are separated by an intervening strip of the maxillary, varying in width from 1 to 18 millimeters, so that the condition described is unquestionably abnormal. It is certainly not a character of any systematic importance as it was originally supposed to be.

Unfortunately no skins from extreme southern Florida are available, and since those from the type locality are quite as well referable to *virginianus*, it may be said that the color characters of this race in its extreme form are still imperfectly known. Hunters at Key West assure us that all the mainland deer undergo a seasonal change similar to that of the deer farther north.

We have seen no specimens from the region between Chokoloskee and Palm Beach, a distance of some 125 miles. The large deer of the latter region must be referred to typical *virginianus*. It may be assumed that the range of *osceola* is along the Gulf Coast to the western tip of Florida, avoiding the Everglades to the east and southeast, where no deer occur, a range similar to that of several other geographic forms.

In general the deer of east Florida are diminishing with alarming rapidity. The open country with scattered "hammocks" and almost invariably with myrtle or bay "heads" centering the hundreds of "prairie ponds" makes the deer the hunter's easy victim. The Florida deer are very strictly nocturnal, never moving about in daytime. They are hunted with slow-trailing dogs which do not give tongue, the hunter usually tying the dog to his belt. When a fresh track is picked out the dog simply leads its master to the thicket or "head" where the deer has chosen to spend the day. If the spot be a small palmetto thicket in the piney woods the deer is flushed at a few feet range and killed with buck-shot; if it has evidently "laid up" in a larger hammock or head the hunter puts in the dog on one side and hurries to the other side of the hammock, or if a group are hunting watchers are posted and the dog is loosed to drive out the deer. In cases where the deer escapes it will usually run an almost incredible distance and no further attempt is made to start it again. Until, however, the hunted deer is actually found by the dog, it lies perfectly still and I (Barbour) have often passed and repassed within ten feet of deer which were afterward started with a dog but which

had kept hidden regardless of my presence, smoking, and conversation. There is no question but that Florida deer winter in the "short blue" and never put on the "long blue" coat assumed by deer that winter in the snow.

Weight.—Cory (1896) says that a full-grown Florida deer "will often not weigh over 110 pounds" although he has killed them considerably larger. A writer in *Forest and Stream* (vol. 70, p. 245, 1908) reports one killed at Kissimmee, and thought to be unusually big, that weighed 135 lbs. without the entrails. Most of the Florida deer which Barbour has seen or heard of, killed about Hallandale, Miami or Homestead were rarely more than 120 lbs. after being dressed. A number of specimens seen in captivity in southeastern Florida were uniformly small.

Measurements.—See table (p. 76).

Specimens examined.—

FLORIDA: Monroe County, Chokoloskee, 6 adult ♂, 1 ♀ subadult (skulls); Polk County, Lake Arbuckle, ♀ yg., ? intermediate (skull); Citrus County, Citronelle, 4 (including type) and Blitche's Ferry, 1 (skins and skulls, regarded as intermediates closely approaching *virginianus*).

Between the mainland of southeastern Florida and the southern group of keys, there is a wide stretch of rather large, elongate islands, including Key Largo and the Metacumbe Keys, on which, at least within the memory of those now living, deer have never been found. Farther south still, however, in the "Lower Keys," there have been a few deer for a very long period. These were formerly known as "Spanish deer" because, apparently, it was recognized that they were unlike the deer of the mainland and it was, therefore, assumed that they had been brought by the Spaniards from Central America, as the Key West "conchs" well knew that dwarf white-tailed deer do occur on the coasts of Honduras and Nicaragua which they visit during their turtling expeditions.

These deer are much pursued and have become extremely wary, but a few are killed each year by hunters with dogs. After considerable effort Barbour finally succeeded in obtaining an adult male skull with scalp from Big Pine Key and a younger male in the second or third year. These, with a third young male shot by Mr. W. S. Brooks on the same key, seem unquestionably to represent a very distinct race, pale in color, small of body, and with reduced tooth rows. It may be named:

Odocoileus virginianus clavium subsp. nov.

KEY DEER

Type.—Adult male head-skin and skull, 19120 M. C. Z. from Big Pine Key, Florida, winter 1920 (said in Key West to be the record for size).

Diagnosis.—Smallest of the eastern races of Virginia deer, colors paler, teeth smaller than in the mainland races; upper cheek teeth 67 mm.

Description.—The type and two other immature males agree in the color of the head: in the former the crown and median dorsal line of the neck are "light buff" of Ridgway, darkened by the "bister" of the basal portions of the individual hairs; on the sides of the neck the bister pales out until on the cheeks and the sides and front of the neck, the color is "pale buff." A spot back of the nose and

on the under lip just ahead of the corner of the mouth are bister and the same color extends back from the muzzle to the fore part of the face, where, however, it is finely grizzled with whitish, as are also the backs of the ears. As usual, the spot behind the muzzle, the eye ring, inside and outer bases of the ears, and the upper throat are white. In other words the tawny hue is quite lacking. A similar difference characterizes the remainder of the winter pelage as shown in the two young male skins (both taken in March). The bister is not so deep, nor is the buff so bright ochraceous as in *virginianus*. The combined effect is to produce a very pale-looking animal very different from comparable specimens from the mainland (Palm Beach and South Carolina).

Skull.—Apart from the small size of the skull and antlers, this deer of the "Lower Keys" differs from all the mainland forms here treated in that the teeth are reduced in size, so that not only the length of the tooth row but also the individual teeth are obviously less than those of the other races, in which as already stated, the tooth row is of practically the same length in adults from Maine to southern Florida. All three of the specimens available agree closely in this respect and differ conspicuously from those of the mainland.

The antlers of the type, which according to local hunters, are of record size for Key deer, lack the basal or "crown" point on the right-hand side, but each has in addition two tines on the main beam. The length of the left antler, measured on the outer curve is 309 mm., of the crown point 42 mm.; proximal tine 90, distal tine 50. The tips of the antlers are 185 mm. apart.

Weight.—A full-sized doe is reliably stated to weigh approximately 65 pounds; the larger of the two immature males (No. 18497) was said to have weighed 80 pounds.

Measurements.—See table.

Remarks.—For additional information on the distribution and status of the Key deer we are indebted to Mr. Bascom L. Grooms, Manager of the Key West Electric Co., who has made particular inquiry on our behalf, especially of Mr. Henry Watkins, who has hunted on the keys for some 35 years. Two other hunters of long experience on the keys have corroborated his testimony.

These small deer are now strictly confined to the southernmost group of keys from Big Pine Key on the northeast to Boca Chica on the southwest, a small island some seven or eight miles from Key West. Big Pine Key has always been known as the chief refuge for the Key deer, and they swim back and forth from it to the smaller islands. From the testimony of Mr. Watkins, it appears that about thirty years ago deer were killed on Key West Island, but none has been seen there since. Deer were killed on Stock Island, a small key adjoining Key West, ten years ago (*circa* 1910) but none has since been known there. Proceeding northeastward, there were deer on Boca Chica until about the same time, when they disappeared, and were unknown there until late in 1920 when two were seen. They disappeared from Saddle Bunches Key about nine years ago (1912). They were also found on Sugar Loaf until the hurricane of 1910 when they disappeared, and none has been seen there since that time until the fall of 1920 when they were again reported from the island. Deer have always been found from time to time on Ramrod Key, all three of the Torch Keys, and probably Newfound Harbor. They swim readily from key to key and if hunted on the smaller islands they leave and go back to Big Pine Key. Later they will again appear on the smaller islands.

"It is safe to say that deer are likely to be found at any time on any key between Big Pine Key and Boca Chica and that they are more plentiful now than they were twelve to fifteen years ago. A good hunter was known to jump six deer in one day on Big Pine Key this last winter, (1920-21), when twelve to fifteen years ago it was not uncommon even with good dogs to be unable to jump a deer" there. On the three small keys just north of Big Pine, known respectively as Crawl, Grassy, and Duck Key, deer are said also to have been found, but none of the present-day hunters has ever been able to find deer on Long Key nor are they known to have inhabited keys to the northward.

The hunters believe that these deer have no special season for breeding and that their summer coat is not essentially different from that of winter. They inhabit the densest cover of thorns, bushes and palmettos and can only be successfully pursued with dogs to chase the quarry past the waiting hunter stationed at some favorable point. After they have been hunted for a few consecutive days they go into the extensive prickly-pear hammocks and remain there for some time, of course, safe from pursuit. This happened coincident with two visits when we were trying for specimens as a result of Cuban hunting parties from Key West.

To one unfamiliar with field conditions in Florida, the very marked faunal differences between the southern keys and those extending northeast to the nearest portions of the peninsula itself, are almost as striking as they are unexpected. These southernmost islands are very different in character from those of the chain running northeast from Big Pine, including Boot Key, Grassy Key, Metacumbe Key and the extended Key Largo. The last, at its northern end, approaches the mainland of the peninsula but is well separated from it by a deep channel through which flows a swift current. These northern keys in all probability have a somewhat different geologic history and origin from the more southern or "lower" keys. The difference in the character of the two groups and their possibly independent connection with the mainland is sufficient to account for the considerable difference in their flora and fauna. For a most interesting exposition of the peculiar environmental conditions obtaining in these islands the reader is referred to the chapter on "The Florida Keys" in Charles Torrey Simpson's delightful book "In Lower Florida Wilds" (1920).

Specimens examined.—

FLORIDA, Big Pine Key, 3 (2 skins and skulls, and the type skull with head skin).

In the table following are given a few comparative skull measurements of the four races here considered. It would seem that after the exhaustive study made by Dr. J. C. Phillips (1920) these would be superfluous in the case of the race *borealis* but we have endeavored to select a few adults of each race, that appeared of maximum size and strictly comparable. This is of much importance for deer do not attain full size until they are several years old, so that cranial comparisons are often valueless unless the largest individuals of a series or those of quite comparable age are contrasted. For immature animals, however, it is possible to make accurate comparisons of several stages, of which we select three, namely: (I), skulls with three upper milk premolars and *first* permanent molar in place; (II) skulls with three milk premolars and *two* permanent molars in place; (III) skulls with three milk premolars and all *three* permanent molars in place. Deer

born in spring, are in stage I during the following fall, and by late spring have reached stage II. A deer with three milk molars and three permanent molars is usually at the beginning of the second fall, and before the third fall (2 yrs. old) has the complete dentition with "dag" antlers in the male.

Adult skulls

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	AUDITOBASAL LENGTH	ZYGOMATIC WIDTH	UPPER CHEEK TEETH	LOWER CHEEK TEETH
<i>virginianus</i> ..	101491 U. S. N. M.	Va., Bath Co.	♂	282	255	126	76	81
<i>virginianus</i> ..	105558 U. S. N. M.	Va., Winchester	♂	—	255	114	79	88
<i>virginianus</i> ..	18945 M. C. Z.	Fla., Palm Beach	♂	290	268	117	77	87
<i>virginianus</i> ..	18944 M. C. Z.	Fla., Palm Beach	♂	—	263	124	81	86
<i>virginianus</i> ..	17759 M. C. Z.	Fla., New Smyrna	♀	256	239	100	79	88
<i>borealis</i>	4999 M. C. Z.	Me., Bucksport	♂	311	283	132	80	82
<i>borealis</i>	1733 M. C. Z.	Me., Upton	♂	289	261	124	81	89
<i>borealis</i>	11458 M. C. Z.	N. Y., Tupper Lake	♀	258	233	102	73	77
<i>borealis</i>	18753 M. C. Z.	Ont., Long Point	♀	262	241	110	76	83
<i>osceola</i>	18596 M. C. Z.	Fla., Chokoloskee	♂	255	234	106	77	81
<i>osceola</i>	18301 M. C. Z.	Fla., Chokoloskee	♂	253	232	99	72	78
<i>osceola</i>	18597 M. C. Z.	Fla., Chokoloskee	♂	—	—	110	77	83
<i>clavium</i>	19120 M. C. Z.	Fla., Big Pine Key	♂	240 [±]	215	106	67	73
<i>clavium</i>	18497 M. C. Z.	Fla., Big Pine Key	♂	195	181	89	62	70

I. Immature skulls, with dp ²⁻⁴ m¹

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	ZYGOMATIC WIDTH	CONDYLION TO P ²
<i>virginianus</i> ..	36971 U. S. N. M.	Va., Highland Co.	♂	195	86	135
<i>virginianus</i> ..	2384 U. S. N. M.	Va., Rowleysburg	♀	—	84	136
<i>virginianus</i> ..	122763 U. S. N. M.	So. Carolina <i>Charleston Co.</i>	♀	199	85	132
<i>borealis</i>	1669 M. C. Z.	Me., Upton	♂	215	89	145
<i>borealis</i>	1675 M. C. Z.	Me., Upton	♀	226	95	154
<i>osceola</i>	61849 U. S. N. M.	Fla., Polk Co.	♀	194	80	130

II. Immature skulls, with $dp^{2-4} m^{1-2}$

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	ZYGOMATIC WIDTH	CONDYLION TO P ¹
<i>virginianus</i> ..	111403 U. S. N. M.	Fla., Brevard Co.	♂	231	88	156
<i>borealis</i>	1695 M. C. Z.	Me.	♀	237	96	156
<i>borealis</i>	4221 M. C. Z.	Me., Bucksport	♂	235	99	160
<i>clavium</i>	18060 M. C. Z.	Fla., Big Pine Key	♂	191	83	131

III. Immature skulls, with $dp^{2-4} m^{1-3}$

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	ZYGOMATIC WIDTH	CONDYLION TO P ¹
<i>virginianus</i> ..	17558 U. S. N. M.	Va., Chesterfield	♀	—	96	156
<i>borealis</i>	83 M. C. Z.	(?) Maine	♀	244	108	166
<i>osceola</i>	18302 M. C. Z.	Fla., Chokoloskee	♀	221	87	151

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EXPLANATION OF PLATES

(All figures one-seventh natural size.)

PLATE 4

FIG. 1. Virginia Deer (*Odocoileus virginianus virginianus*), 38693 U. S. Nat. Mus., from Cumberland, Maryland. Adult male with large, normally developed antlers.

FIG. 2. Northern Virginia Deer (*Odocoileus virginianus borealis*), 13240 M. C. Z., from Oxford County, Maine. Adult male with average normal antlers, showing the tendency to spread at the tips.

PLATE 5

FIG. 3. Virginia Deer (*Odocoileus virginianus virginianus*), 19118 M. C. Z., from near Palm Beach, Florida. Adult male, with abnormally erect antlers, their tips nearly in contact.

FIG. 4. Key Deer (*Odocoileus virginianus clavium*), 19120 M. C. Z., type, from Big Pine Key, Florida. Said to be a very large head for this race.

FIG. 5. Florida Deer (*Odocoileus virginianus osceola*), 18597 M. C. Z., from Chokoloskee, Florida. Adult male, with large normal antlers.

FIG. 6. Same, 18596 M. C. Z., Chokoloskee, Florida, adult, with average normal antlers.

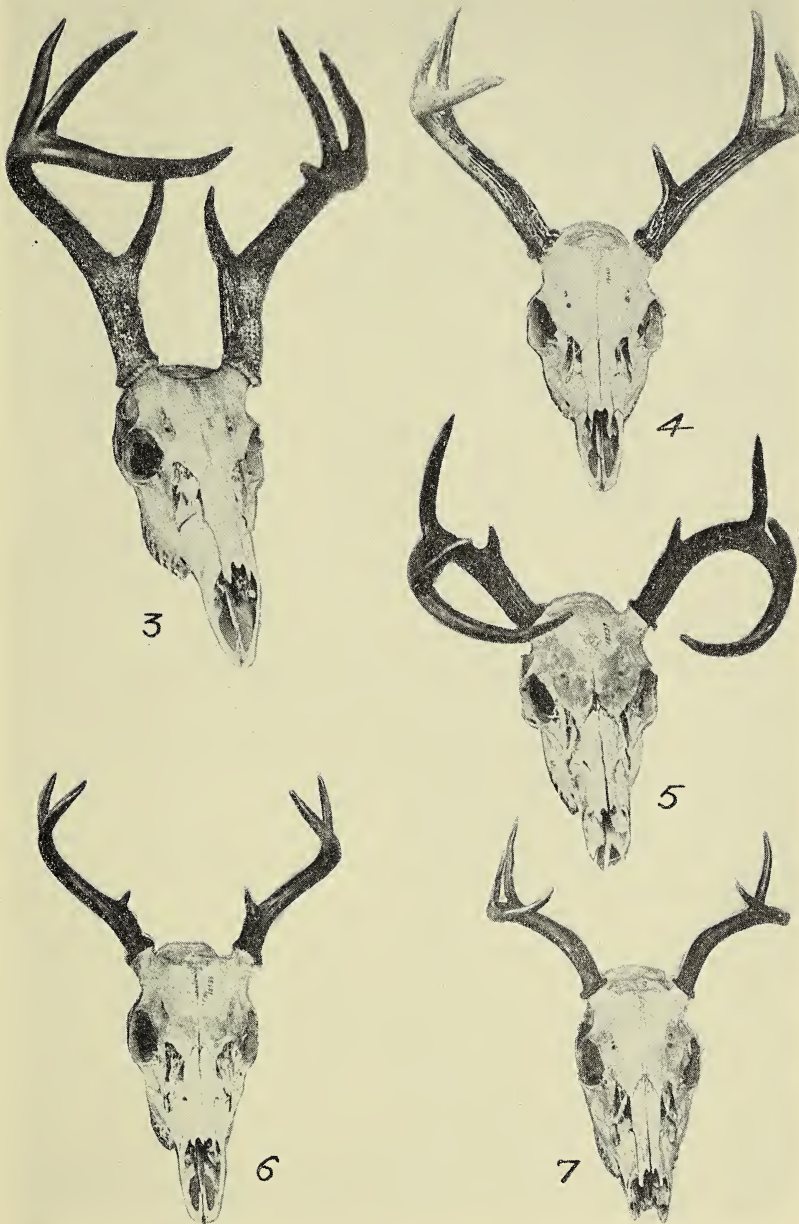
FIG. 7. Same, 18598 M. C. Z., Chokoloskee, Florida, adult. The antlers are asymmetrical in the number of points and lack the basal or "crown" tine.

Cambridge, Mass.



SKULLS OF WHITE-TAILED DEER

(Barbour and Allen: White-Tailed Deer.)



SKULLS OF WHITE-TAILED DEER

(Barbour and Allen: White-Tailed Deer.)

LONGEVITY IN PEROMYSCUS

By F. B. SUMNER

Various writers have doubtless recorded observations bearing upon the longevity of rats and mice, but very few of these have come to my notice. No careful search for such records seems profitable, however, in connection with the publication of the following brief notes of my own. I shall therefore proceed without making any extensive display of references to "the literature," and shall ask the indulgence of those whose publications I have overlooked. It is worth mentioning that I find rather wide differences among the estimates which lie at hand. Weismann, in his well-known essay on "The Duration of Life" states that a "mouse" (presumably he means a house-mouse) lives six years, while the anonymous author of the booklet "Fancy Mice" assures us that, if properly cared for, mice "will live for two or three years, and then die of old age." The white rat, according to the extensive observations of Donaldson and his co-workers, is to be regarded as very old at the age of three years (i.e., comparable with a man of 90), while the female commonly becomes sterile at the age of 15 to 18 months.

With deer-mice, as in the case of most wild animals, there would seem to be no way of testing the natural span of life, except by rearing them in captivity, from birth until the time when they finally succumb to "old age." The period thus measured doubtless does not fairly represent the average life cycle in nature. On the one hand, the conditions of captivity, as I have more than once pointed out, do not make for normal development on the part of all individuals. Sterility, stunting and even deformity, may be the result of these artificial conditions. In the mouse's favor, on the other hand, is the fact that it is protected and fed throughout life, a circumstance which is of particular importance during the period of old age. Thus, several of the mice referred to below became extremely feeble many months before death occurred. Such animals would doubtless have died or been killed much earlier in a state of nature.

In September, 1916, ten mice (five of each sex) were selected from the first cage-bred generation of *Peromyscus maniculatus gambeli*, belonging to the local (La Jolla) strain. These mice were, at this time, about a year old. They were normal, healthy specimens, but not otherwise exceptional. Two of these animals met with an accidental death, when more than two years old; another met with a

presumably "natural" death at a date which was unfortunately not recorded. This mouse is known, however, to have reached an age of at least 3 years and 2 months.

The remaining seven individuals died at the following ages:

♀ 71.....	3 years, 0	months
♂ 20.....	3 "	4 (+) "
♀ 11.....	4 "	2 "
♂ 39.....	4 "	5 "
♀ 81.....	4 "	8 (+) "
♀ 2.....	5 "	3 (-) "
♀ 22.....	5 "	8 (-) "

Thus, five of these mice attained an age of more than four years, while two attained an age of more than five years. The patriarch (or rather, *matriarch*) among them reached the ripe age of 5 years and 8 months.

In all of these seven cases, death resulted from disease or "old age." Several of the mice became extremely senile and "wobbly" long before death occurred, and it was noted that several of them were very much affected by cold. Such individuals became numb and feeble on cold days, and it is perhaps significant that five of the deaths occurred during the winter or late fall.

No obvious changes occurred in the appearance of the senile pelages, though the two oldest of these have been saved for more careful study. It is worth noting that of the two which died in the sixth year one was dark and the other somewhat buff, representing the normal range of variation in adult individuals of this subspecies. It was noticed that one of the males, in middle or late life, acquired a curious "grizzled" appearance in the hair of the face, giving him a decidedly venerable appearance. I found, however, that this was a hereditary peculiarity of the family to which the grizzled mouse belonged. It was noted in at least four other individuals, in some cases while the animals were still young.

Unfortunately, my records, as regards the fertility of this "old age" stock, are very meagre. At the commencement of the experiment, all were mated, except one male, which was kept apart until he was nearly three years old, and then mated. No record was kept of the earlier broods resulting from these matings. It is probable that some of the individuals were sterile from the outset, a condition not infrequent among cage-bred *Peromyscus*.

My few positive results bearing on the duration of the reproductive period are as follows. One pair (♀ 2 and ♂ 21) produced a brood of five or six young, when at the age of 31 months. Two of these reached the age of 4 months and were then killed. The father met an accidental death not long after, and the mother was mated to ♂ 20, whose fertility was unknown. No further broods resulted.

Another pair (♀ 81 and ♂ 39) produced one brood at the age of 33 months, and another when more than 34 months old. They were remated about 5 months after the birth of this last brood, but no further young were produced, though these mice lived together for more than a year. The two broods referred to contained but two individuals each, and of these four only two reached the age of two weeks. From these facts and those mentioned in the preceding paragraph, it seems possible that the offspring of parents of this age tend to be weak. But such sickly broods may be born to parents at any time of life, and the results here cited may have no relation to the age of the parents.

Females 2 and 22, when nearly five years old, were mated to a fertile male of another lot, but no young resulted, as might have been confidently expected.

A record for two other mice of my stock is worth reporting here. The pair in question were wild ones, whose age, at the time of trapping, was of course unknown, though they were probably at least several months old at the time. Their last brood was born very nearly three years later.

The salient facts in the foregoing discussion seem to be that one mouse of the subspecies *Peromyscus maniculatus gambeli* is known to have reached the age of five years and eight months in captivity, while two pairs are known to have produced young when both parents were nearly or quite three years old.

Scripps Institution, La Jolla, Calif.

THE PRONG-HORN

By M. P. SKINNER

[Plates 6-9]

The prong-horn is found only in North America, where it is one of the most characteristic animals. It is peculiar in that the horn sheath is shed every year, leaving the core, which is an integral part of the skull, in place; in that the horns have a prong, hence the name, prong-horn; in that the coarse hair is of very peculiar form and character; and in that all the hair of the rump, surrounding a musk gland, can be erected. It has wonderful eyesight; and is capable of great speed.

Family ANTILOCAPRIDAE. Prong-horn Antelopes

Closely allied to the Bovidae, but the horns deciduous and branched (Flower and Lydekker).

Genus *Antilocapra* Ord

Antilocapra ORD, Journal de Physique, vol. 87, p. 149. 1818.

Type of genus.—*Antilope americana* Ord, 1815.

Dentition of genus. I $\frac{0-0}{3-3}$ C $\frac{0-0}{1-1}$ P $\frac{3-3}{3-3}$ M $\frac{3-3}{3-3}$ 32.

Characters of genus.—Bony horn cores unbranched, forming vertical, blade-like projections immediately above the orbits; horns compressed, about 250 mm. in length, in a straight line, or 400 mm. following the curves, having a gentle backward curvature, the short branch or prong arising about the middle of its height. When the horn is about to be cast off, it becomes loosened and a new one covered with long hairs, which soon disappear, is formed upon the bony core beneath it. The ears are long and pointed. Tail short and pointed, densely coated with coarse hair, except on the underside where the hairs are extremely short. The neck has a thick mane of long chestnut colored hair. Accessory hoofs are wanting. The lachrymal sinuses of the true antelopes are undeveloped; as also are the "inguinal pores," or groin sacks found in true antelopes.¹

SUBSPECIES

Antilocapra americana americana (Ord), 1815. Described from the "plains and highlands of the Missouri," and including most of the range of the Prong-horn.

Antilocapra americana mexicana Merriam, 1901. Mexican Prong-horn Antelope. Described from Sierra en Media, State of Chihuahua, Mexico. Sonoran and Transition zones of northern Mexico, extending north into the United States, along the Mexican border.

¹ Mearns, Bull. 56, U. S. Nat. Mus., pp. 220-221, 1907.

Antilocapra americana peninsularis Nelson, 1912. Described from forty-five miles south of Calmalli, Lower California. This animal is probably confined to the peninsula of Lower California, Mexico.

Although this animal is known all through the west, and throughout American literature, as the antelope, we have no true antelopes in this country,² for all the existing animals of the group, including the gazelles, are Old World species and mainly of African habitat. This is the only animal in the United States that approaches them at all in form and habits. It is the sole representative of its genus and family, for the peculiarities of the horns and their growth are deemed sufficient to justify a separate family, intermediate between the giraffes and the Bovidæ. It is known generally as American Antelope, Prong-horn, or Prong-buck, and was called Cabree and Cabrit by the Canadian French trappers.

A full-grown prong-horn is smaller than most adult American deer. The bucks are slightly larger than the does. The robust and somewhat chunky body, which supports a short, thick-set neck carrying erect a large head, is quite different in form from that of a deer. The tail is very short, and the limbs are slim and rather short.

The coloring is made up of white and fawn, with black and brown markings about the head and neck. The white occupies all of the under surface of the body, extending down the inner side of the limbs and also well up on the sides of the body, where a rectangular area between the shoulder and hip is formed. The rump, with the exception of a narrow fawn strip usually connecting the upper surface of the tail with the colored area of the back, is white; and when erected in fright or excitement, it catches the sun and gleams out brightly. The lips and chin are white; in the mouth parts, the mucous membrane and naked areas are coal black. White also are areas on the cheeks, throat, and inner surface of the ears, besides which the neck, underneath, is beautifully marked with a white crescent above, and a white shield below. Fawn occupies the back and most of the neck, extending down the outer sides of the limbs until it encircles them low down, and also extending backward in a narrow line dividing the rump and terminating on the basal part of the tail. This fawn color becomes more tawny on the neck, and the elongated hairs of the short, erect mane are russet, tipped usually with black in varying amount. The head, which varies from creamy white on the sides to wood brown above, is marked with

² The Rocky Mountain goat is the nearest approach to the Old World "antelopes" among the American Bovidæ.

brownish black in the male. There are white areas around the horns and at the base of the ears. The blackish markings are much more noticeable on the old males than on the does and younger animals. In typical *americana* the black sometimes occupies the whole face below a line connecting the horns, but usually this area is T-shaped with the horizontal line between the horns and the vertical line down the nose. In *mexicana* and *peninsularis*, the blackish area becomes dark brown, and is more restricted. In all forms, the eyelashes are jet black. There is a black edge to the ear, and a black line, in the male, outlines the edge of the lower jaw, starting just below the ear and extending down for several inches, less on younger bucks than on older animals. This latter is a sex mark, distinguishing the male at all ages, and even appearing on some fetal specimens. The tail is white, or nearly so. The small pointed hoofs are double and black; the two small rudimentary hoofs, usually seen on ruminant animals on the rear legs above the genuine hoofs, are absent.³

The amounts of black, brown, and white differ in this animal according to season, sex, and age.

Young prong-horns, until a month or two old, are paler than their parents, and the rump patch is tinged with pale russet and is not distinct—but it is interesting to observe that the rump can be erected by a kid but a few hours old—indeed all of the pattern is obscure, the white areas are stained with dull buff, and the blackish parts are only faintly indicated. Little curls of dusky hair mark the location of the coming horns of the male.

A full-grown prong-horn is about four and a half feet long and between three and four feet high at the withers. A few weights are recorded by Mearns: an adult male weighed 112 pounds as killed, after bleeding; an adult female weighed 109 pounds as killed, after bleeding; three adult males weighed 64, 56, and 67 pounds, respectively, after removal of head, feet, skin, and viscera.

The ear stands erect when the prong-horn is at ease, giving the animal an alert and striking appearance. When he becomes excited, the ears, which are wonderfully acute, are projected forward to catch the slightest sound. They are five inches high, three inches broad at the widest place, terminate in a point, and are covered inside and out with hair.

The eyes are black, lustrous, very expressive, and so large that taxidermists find them to exceed those of the horse and ox in size, and to be very nearly equal to those of the elephant.

³ Adapted from Mearns, Bull. U. S. Nat. Mus., No. 56, pp. 221-222, 1907.

In summer the hair of the prong-horn is smooth and flexible, but as winter approaches it lengthens; each hair becomes thick, the interior whitens and grows spongy, and it loses flexibility, at last becoming brittle, so that its point is easily rubbed off. It also loses its elasticity, so that when once bent it will not straighten again. A coat of fine, white fur is found next the skin, particularly in winter; and forms a close and warm covering for the wearer. Doctor Murie has shown that the prong-horn is peculiar among ruminants in possessing hair with markedly denticulate cells in the medulla. In the spring, usually during the latter part of March in the Yellowstone, the long hair is shed, beginning about the face, and is replaced immediately with shorter hair that has started to grow previous to the shedding.

In female prong-horns the horns are sometimes absent or abortive, occasionally quite large, but usually range from one to three inches long and are not branched; the horns of the adult female are invariably much smaller than those of the buck. The rudimentary horns may be detected on the buck at birth, but not so in the case of the doe. The prong-horn differs from the true antelopes in the deciduous nature of the horny sheaths covering the cores. It is interesting to observe that an early printed statement about the shedding of an antelope's horns was a denial by Audubon and Bachman (1851), that they could be shed at all. This in spite of the fact that hunters at Fort Union (now Buford, N. D.) reported to Audubon that the prong-horns did shed and renew their horns annually. And from that date down to the present time the controversy has cropped up at recurrent intervals, although it has been definitely known for some time that the horns are regularly shed, but that the method and details are quite different from those of other animals. Here in the Yellowstone, at least, every buck prong-horn sheds his horn sheaths every year during November and December. At that time of year, our animals are on a restricted range and it is comparatively easy to find them all. In the course of several seasons I have noted that bucks with old horns are to be seen until the early part of December, and, after that time, all the bucks are growing new horns. No complete horns are again seen until the first of the new horns have finished their growth towards the end of January.

The horn cores (which are *not* shed) are spikelike, rising over the great eye orbit and leaning outward, and are not branched. They are essentially processes of the frontal bone of the skull, consisting of simple flattened blades of the bone, and are covered by the horny sheath which has a decurved tip and a prong, the latter a short triangular

snag extending out in front of the middle. Below the prong, the sheath is much compressed laterally to the base; but above the prong, it becomes truly cylindrical.

In early November the horn sheath becomes loosened at the base, although still held in position by long hairs imbedded in its substance and still rooted in the epidermis, and is slowly pushed off by the new horn sheath and the stiff, bristle-like hairs forming beneath. The pushing-off process is very gradual and almost invariably one sheath falls before the other; only once have I ever found a pair of sheaths together and that was in a "bed" where the antelope had lain for some time. Apparently the buck never rubs, nor strikes, his horns to free them, as an elk or a deer usually does. In fact, in several instances I have seen the horns thrown off by a sudden jar: such as, a sudden frightened jump, or the breaking of a snow crust under the animal. The imbedded hairs are mostly broken short off, but a few may be pulled free from the sheath. The shed sheath is fringed at the bottom with the ends of hairs still fast in the horn material and usually the interior of the sheath is also lined with hair. The shed sheaths immediately become articles of food for coyotes, badgers, porcupines; and even the antelopes, themselves, have been seen nibbling them. Later, after the snow is gone, mice, gophers, and ground squirrels assist in the destruction. The sheaths that escape until May begin to turn red on the side nearest the ground, and to crack and splinter, especially on the side towards the sun. This disintegration proceeds very rapidly where conditions of moisture and dryness alternate, less rapidly where moisture is constant, and still more slowly where the ground remains dry. Provided that no animal has eaten them, the sheaths are completely destroyed in from one to three years, depending on conditions already spoken of, on amount of rainfall, and on amount of exposure to dry, hot winds. Naturally the hard, compact tip is the last part to disappear. Even when freshly fallen, the sheaths are inconspicuous and not often found unless specially looked for. This differs in many respects from the process where the bony antlers of deer and elk are shed. Under the same conditions, the latter antlers are almost indestructible. Furthermore, as they "weather" they bleach and become white and are very easily seen even at a long distance.

When the sheath is off, one finds on the tip of the horn core a soft, fleshy, nipple-like process, loose and hairless and fast hardening and changing to true horn. About the base of the horn core and up to

the nipple, is a thick velvety membrane, a special development and continuation of the outer skin, carrying long, bristle-like hairs with more of these hairs extending up the horn from the base of the core. This membrane and the bristly hairs gradually agglutinate into the nipple. The agglutinated material becomes true horn, the change slowly proceeding towards the base until the whole core is sheathed with horn in which the remaining unchanged bristly hairs are imbedded, even to the very tip of the prong and well up towards the main tip. At the time the old horn is shed in November, the new horn extends down from the tip from half an inch to two inches according as the sheath was prematurely shed or not. The horny sheath forms, and extends downward about two inches per month until January first, and then about fifty per cent faster until the first of March, when the horn, in normal adult bucks, is almost a foot in height, is curved back and inward, sometimes so as to be truly lyrate. The horns of both sexes are normally black, but the bucks manage to use theirs enough to keep the tip worn down so as to expose a bit of whitish horn material beneath. The prong (one is normal but occasionally an extra one appears or two appear beside the larger one) on the growing sheath starts to grow about January first, appearing as a small button just discernible through the hair still extending up more than half the length of the coming horn. The prong grows with the sheath to completion at the same time; as it grows it loses its bluntness and becomes compressed and sharp. The horns of the kids, very small and not easily seen the first summer, start active growth in February when the kid is about ten months old and gradually swell up two inches during the next two months, and may grow from the base for ten months longer to a total height of four inches. Afterwards the horn is shed and renewed as already described. The prong appears sometimes before the youngster is two years old, but is then hardly more than an indication of what it becomes later. Horns continue to grow larger each year until the animal's full growth is attained at the age of five. The fully developed horn is recurved and normally the tip inclines inward, but on a few rare occasions I have seen the tip turned forward instead of back. This variability in direction of the recurved tip is probably due to the fact that the horn core does not extend into the bend of the sheath and therefore cannot direct its growth. Neither does the prong have the benefit of any support from the core, and its tip usually turns in more or less. The core, however, is widened, or at least marked by an abrupt angle, under the prong.

Observations on the growth and replacement of the horns of the female are lacking as yet, but I believe the process to be essentially the same as with the bucks.

Horn measurements taken from "Hunting in Many Lands," Boone and Crockett Club series:

No. 12 Theodore Roosevelt, Medora, North Dakota, September, 1884, girth $6\frac{1}{2}$ inches, length 16 inches.

No. 13 A. Rogers, girth 6 inches, length $12\frac{1}{2}$ inches.

No. 14 A. Rogers, girth $6\frac{1}{4}$ inches, length $10\frac{7}{8}$ inches.

No. 13 measured from tip to tip, $6\frac{1}{8}$ inches. The greatest width inside the horns was $8\frac{5}{8}$ inches; the corresponding figures for No. 14 were $7\frac{3}{4}$ and $10\frac{1}{4}$ inches.

From the date when the prong-horn was first made known to science on the return of Lewis and Clark, down to the present day, it has been a favorite subject of literary efforts; many of which I regret to say, have been very fanciful. On September 5, 1804, Lewis and Clark "saw some goats or Antelopes, which the French call Cabres," (Sergeant Gass) near what is now Greenwood, South Dakota, and very close to the present state line between Nebraska and South Dakota.

Washington Irving's "Astoria" gives a good early description:

There are two kinds of antelopes in these regions, one nearly the size of the common deer, the other not much larger than a goat. Their color is a light gray, or rather dun, slightly spotted with white; and they have small horns like those of the deer, which they never shed. Nothing can surpass the delicate and elegant finish of their limbs, in which lightness, elasticity, and strength are wonderfully combined. All the attitudes and movements of this beautiful animal are graceful and picturesque; and it is altogether a fit subject for the fanciful uses of the poet, as the oft sung gazelle of the east.

Their habits are shy and capricious; they keep on the open plains, are quick to take alarm, and bound away with a fleetness that defies pursuit. When thus skimming across a prairie in the autumn, their light gray or dun colour blends with the hue of the withered herbage, the swiftness of their motion baffles the eye and they almost seem unsubstantial forms, driven like gossamer before the wind.

While they thus keep to the open plains and trust to their speed, they are safe; but they have a prurient curiosity that sometimes betrays them to their ruin. When they have scud for some distance and left their pursuer behind, they will suddenly stop and turn to gaze at the object of their alarm. If the pursuit is not followed up they will, after a time, yield to their inquisitive hankering, and return to the place from whence they have been frightened.

John Day, the veteran hunter already mentioned, displayed his experience and skill in entrapping one of these beautiful animals. Taking advantage of its well known curiosity, he laid down flat among the grass, and putting his handkerchief on the end of his ramrod, waved it gently in the air. This had the

effect of the fabled fascination of the rattlesnake. The antelope gazed at the mysterious object for some time at a distance, then approached timidly, pausing and reconnoitring with increased curiosity; moving round the point of attraction in a circle, but still drawing nearer and nearer, until, being within the range of the deadly rifle, he fell a victim to his curiosity.

In "Bonneville," Irving gives an interesting description of quite a different method of hunting as practiced by the Indians:

One day, the scouts, who had been ranging the hills, brought news of several large herds of antelopes in a small valley at no great distance. This produced a sensation among the Indians, for both tribes were in ragged condition, and sadly in want of those shirts made of the skin of the antelope. It was determined to have a "surround," as the mode of hunting that animal is called. Everything now assumed an air of mystic solemnity and importance. The chiefs prepared their medicines or charms, each according to his own method, or fancied inspiration, generally with the compound of certain simples; others consulted the entrails of animals which they had sacrificed, and thence drew favorable auguries. After much grave smoking and deliberating, it was at length proclaimed, that all who were able to lift a club, man, woman, or child, should muster for "the surround." When all had congregated, they moved in rude procession to the nearest point of the valley in question, and there halted. Another course of smoking and deliberating, of which the Indians are so fond, took place among the chiefs. Directions were then issued for the horsemen to make a circuit of about seven miles, so as to encompass the herd. When this was done, the whole mounted force dashed off, simultaneously, at full speed, shouting and yelling at the top of their voices. In a short space of time, the antelopes, started from their hiding places, came bounding from all points into the valley. The riders now gradually contracting their circle, brought them nearer and nearer to the spot where the senior chief, surrounded by the elders, male and female, was seated in supervision of the chase. The antelopes, nearly exhausted with fatigue and fright, and bewildered by perpetual whooping, made no effort to break through the ring of the hunters, but ran round in small circles, until man, woman, and child beat them down with bludgeons. Such is the nature of that species of antelope hunting, technically called "a surround."

Audubon on his famous trip up the Missouri River was intensely interested in the prong-horn and wrote:

Observe now a flock of these beautiful animals; they are not afraid of man—they pause in their rapid course to gaze on the hunter, and stand with heads erect, their ears as well as eyes directed toward him, and make a loud noise by stamping with their forefeet on the hard earth; but suddenly they become aware that he is no friend of theirs, and away they bound like a flock of frightened sheep—but far more swiftly, even the kids running with extraordinary speed by the side of their parents—and now they turn around a steep hill and disappear, then perhaps come in view, and once more stand and gaze at the intruder.

Judge Caton says:

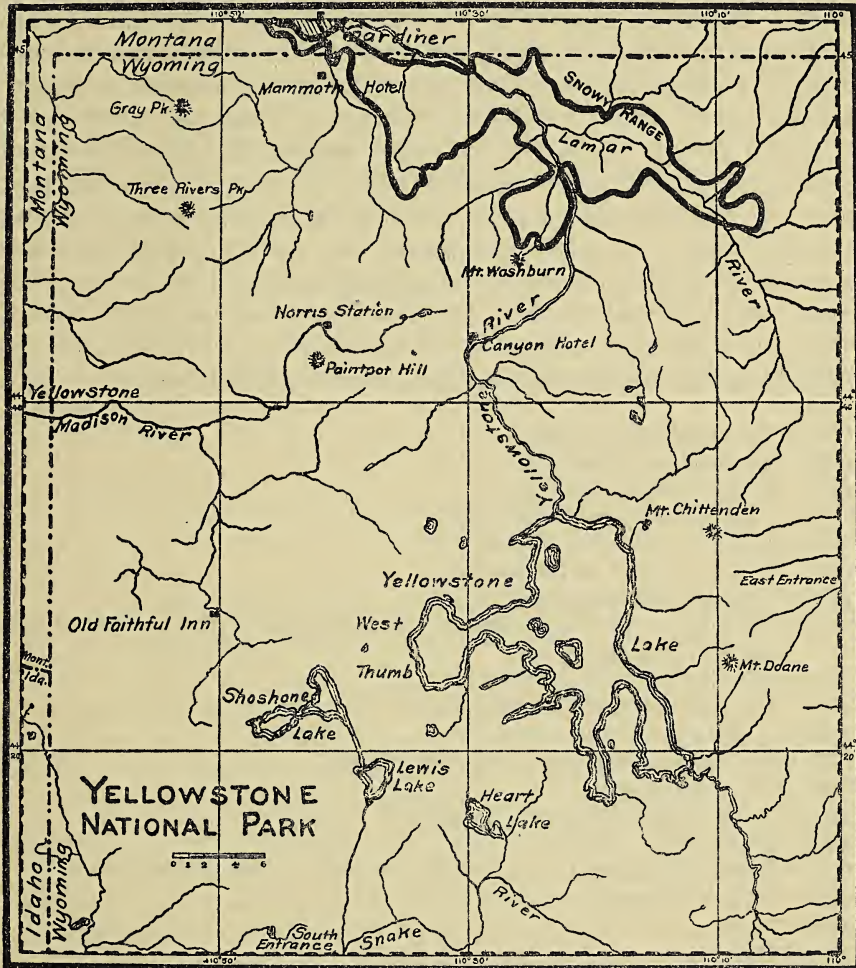
Our antelope was an essential article of food among the aborigines inhabiting the country which it frequented before the introduction of fire-arms among them. They had various modes of capturing it, chief among which was the bow and arrow. This mode involved the necessity of getting a very close range. This could be done only by some kind of artifice, or by the most skillful and cautious stalking, always remembering its defective eyesight, its acute senses of hearing and smelling, as well as its inordinate curiosity. The latter infirmity was taken advantage of by the savage, who, approaching the game as nearly as he safely could from behind the sage bushes or other concealing object, exhibiting in irregular motion a piece of the tanned skin of the animal, colored red or white, or some other attractive object, would attract the game. When the attention of the antelope is attracted by such an object alternately appearing and disappearing, its curiosity becomes excited and an interesting struggle commences between that and its timidity; it will approach cautiously, then retreat a little, then prance around, drawing towards the object gradually, till it is finally brought within bowshot. Then it was that the Indian would let fly his arrow from his concealment, or spring to his feet, the arrow to the string, and the bow partly drawn, and strike his victim before his fleetness could carry him beyond reach.

In former days the prong-horn ranged from central Iowa to the Pacific Coast and from the Saskatchewan River to the interior of Mexico, most generally on the open plains or in broad valleys. There is no record of it being east of the Mississippi in historic times, no bones found even in the old Indian mounds, and no traditions among any of the eastern Indians.

While the present range is smaller than that of the early nineteenth century by only a few hundred miles on the east and west, the former great abundance, computed to have been as great as that of the buffalo, has sadly dwindled until now probably less than three thousand head are all that remain. As an instance of this decrease let me cite a recent report from Colorado which says that, although there are a few prong-horns left in the eastern part of the state, there is only a lone one left of the thousands that used to roam in North Park. Dr. Edgar A. Mearns in "Mammals of the Mexican Boundary" has this to say of the southwestern form, *mexicana*:

The prong horn antelope is already [1907] a rare animal in the region of the Southwest, where it ranged in thousands twenty-five years ago. In much of the region covered by my field notes of the eighties no antelope can be found at the present day. The antelope was not uncommon from the Rio Grande to the Animas Valley during the operations of the International Boundary Commission, and antelope and deer were largely depended on for a supply of fresh meat.
. In 1884 great herds of them could be seen in crossing the Terri-

tories of New Mexico and Arizona by rail. Herds were frequent between Ash Fork and Whipple, along the stage route in March, 1884. At that time thousands of them were killed annually around the San Francisco and Bill Williams mountains, but none remained in the immediate vicinity of Fort Verde. About that time hunters began to comment upon its rapidly decreasing numbers throughout the region, and by the year 1888, it had become comparatively uncommon except in restricted areas still unoccupied by the whites.



DISTRIBUTION OF PRONG-HORN ANTELOPE IN YELLOWSTONE PARK

The dark line includes the antelope range, 100,000 acres.

The cross-lines indicate the winter range, 3,000 acres.

In the Yellowstone the range is restricted to the great open section in the north, comprising the Gardiner Valley, Mount Everts, Blacktail Deer Valley, the slopes on both sides of Hellroaring Creek, Junction Valley, the lower slopes of Mount Washburn on the north, the lower and upper valleys of the Lamar River, and Specimen Ridge. The whole area is below 6500 feet elevation except the table-land of Mount Everts, the upper parts of the Blacktail Deer Valley, the slopes of Mount Washburn (extending to 7300 feet), and Specimen Ridge (extending to 8000 feet above sea level). The total range includes about a hundred thousand acres out of the park's two and a quarter million acres. Of this habitat the summer range of ninety-seven thousand acres is ample, but the winter range of only three thousand acres is far too restricted, especially when snows cover the larger part of it. Forty years ago, limited numbers ranged the Swan Lake and Hayden Valleys, but such is no longer the case. Probably in former days, before white men began changing the environment, prong-horns were more numerous in the park in summer and less so in winter. That our herds have suffered a serious depletion is evidenced by the following estimates from the Superintendent's annual reports:

- 1877—"Thousands of antelope."
- 1880—"Abundance of antelope."
- 1885—"Several bands of antelope."
- 1886—"Antelope are here in large bands."
- 1887—"Large numbers of antelope."
- 1891—"Numerous, and on the increase."
- 1892—"Thriving and increasing."
- 1893—"One herd of four to five hundred wintered on Mt. Everts, and one or two smaller herds elsewhere."
- 1894—"500 wintered on Mt. Everts."
- 1895—"800 wintered on flat near Gardiner."
- 1896—"A great increase in number."
- 1897—"500 wintered in valley and on Mt. Everts."
- 1898—"Are yet numerous."
- 1899—"Not more than 700-800 in the park."
- 1900—"Increasing."
- 1902—"Number of bands of from 50 to 100 wintered on slopes of Mt. Everts."
- 1903—"1000 estimated."
- 1904—"1150."
- 1905—"1500."
- 1906—"1500."
- 1907—"1500."
- 1908—"2000."
- 1909—"Increasing."
- 1910—"600-700" (the balance reported to have escaped from the park).

1911—"450 counted."
1912—"500."
1913—"Increased slightly."
1914—"600 counted."
1918—"350."
1920—"300."

While the reports of the earlier years tell of thousands of prong-horns in the Yellowstone, it must be remembered that then there was nothing to prevent the animals from flocking up from the plains. Gamekeeper Young states in 1881 that "very few of the deer or antelope wintered anywhere in the park." A migration now to the plains would be slaughter, for if an antelope gets out of the park, it is gone as if swallowed up. The 1887 report is the earliest one mentioning that it was found necessary occasionally to drive the antelopes back from the boundary.

From 1872 to 1883 it is reported that antelopes were killed each year in the park "by the thousands." The Rules and Regulations of those days read: "All hunting, fishing, or trapping within the limits of the Park, except for purposes of recreation, or to supply food for visitors or actual residents, is strictly prohibited." And even these extremely wide-open rules were not enforced; it rather seems to have been the policy of the superintendents and their assistants to beg (!) the shooters to be moderate in their activities. With the incoming of the military regime in 1886, the rules (grown more stringent) were enforced, but there was no punishment provided for illegal hunting until 1894.

As a rule prong-horns confine themselves to the great open plains and the broader interior valleys of the mountains. They do not browse, the forest does not contain their food, and the great open ranges give their marvelous speed and matchless eyesight full scope to serve them. Still, like most rules, this has its exceptions. Frequently I find prong-horns in more or less open, stunted growth consisting of aspen, willows, or Douglas fir; often when surprised in restricted areas they show no hesitancy in entering timber to escape. Stranger still, it is reliably reported that in the southwest, prong-horns habitually lived in the open yellow pine forests of certain elevated sections.

Unless there is a scarcity of food, individuals of the antelope tribe remain within a small area of a few hundred acres. Usually they are to be found lying on some favored knoll, where they can see in all directions and can give their sense of smell full play to discover an enemy. In winter, the hilltops have the added attraction of being

swept clean of snow. Still, broad and level meadows are also favorite feeding grounds, especially on windy days.

When on migration, antelopes may travel a score or more of miles in a day. On the plains, in the old days, migration was the regular thing and well known to the hunters who frequented the spring and fall routes. Even here in the Yellowstone where the total migration is limited to thirty miles, three days is enough for these animals to travel from the winter range to the extreme limits of the summer habitat. The winter range is occupied until the latter part of February, when the large bands break up into smaller groups and the individuals show their uneasiness by keeping up near the receding snow-line; and, at the very first opportunity in early April, they break through the passes on Mount Everts and up the Yellowstone River to the summer ranges to the west. The day after they get through, they arrive on the southern slopes of the Hellroaring section, and two days later are in the upper Lamar Valley. During the migrations, it is a doe that leads the band, even though there may be several adult bucks present. But this rule is not invariable, for, about once in twenty cases, I find a male leading, especially if the band be small. Occasionally a mated pair make the migration together, for prong-horns are affectionate and much less quarrelsome than others of the large mammals. They remain throughout the summer on the higher ranges, and the first return movement becomes noticeable about September first when they move down from the heights of Specimen Ridge. As a rule the fall migration is a gradual one, the prong-horn population moving forward as a whole a mile or two a day with many halts, unless an early storm accelerates the movement. About the same time that the migration starts at the western end, the first migrants appear at the eastern end on the winter range. While the migrating prong-horns remain in pairs and small groups in September and early October (or the duration of the rutting season), they begin to gather in large bands soon after that. During October, all the antelopes leave the upper Lamar Valley, Junction Valley, and the Hellroaring Range. Some linger a few days on the forage ranges about Blacktail Deer Creek, and many stay during November on Mount Everts; but usually by December first all are on the lower ranges just across the park boundary from Gardiner, Montana, extending up the lower slopes of Mount Everts. To be sure this schedule is average; weather conditions may retard or accelerate the movement considerably at any stage. Even on the winter ranges temporary changes of weather cause the prong-horns to move up or down

as the snow-line changes and uncovers more or less ungrazed forage. In spite of their warm coats, these animals are susceptible to changes in temperature and are prone to seek shelter, especially from cold north winds. On the other hand, they do not seek shelter in summer from the blazing sunlight. In common with many other animals, they have some sense of foretelling weather changes and when we observe a certain nervousness and uneasiness in the prong-horn bands, we have learned to look confidently for a storm in a day or two.

As with all animals, there are erratic individuals in the antelope herds. A few stay all summer on the lower ranges, and one winter was notable for the successful stay of a small buck in the willows along the Lamar, where he subsisted on hay spread each day in the buffalo pasture at the Buffalo Ranch.

The migrating bands of the old days on the great plains numbered prong-horns by the thousands and those on the northern plains regularly moved south with the first fall of snow. But by the beginning of the twentieth century their numbers had fallen to such an extent, and the individuals had scattered so far, that large herds could gather no longer.

The prong-horn has a wonderful eyesight. As Geo. W. Wingate says, "the hunter must never assume that any antelope he sees, even with a glass, is not watching his movements." Not only is the eye large, but it is placed on the side of the head in a prominent place so that it indeed seems "that they can look out of the back of their heads." Personally I have had animals a half to three-quarters of a mile away see me the instant I moved an inch. Timid and suspicious as they are, they are liable to panic, and will dance up and down; but when once started they are very fleet for a short distance. Unless in good condition, they may then become fatigued. When going slowly, they walk or trot, at times making use of a gait consisting of a series of stiff-legged bounds; but when in a hurry, they run, hugging the ground closely and using every available ounce of strength to accomplish distance. So amazing is their speed, even faster than the deer's, that it is frequently said that "them antelope have sure stampeded." With first-class greyhounds and good horses prong-horns can sometimes be run down, but without these dogs the best a good horseman can do is to get within two or three hundred yards. The average breed of dogs stand little chance, even when hunting in packs, for the antelopes usually run away from them. Prong-horns, when once started, are very loath to change their course so that it is often possible to dash quite close to them by darting ahead at an angle towards their line of

flight. They can make astonishing horizontal leaps, but are not high jumpers ordinarily.

Cutaneous glands and hair tufts are absent from the limbs, but occur at the base of each ear, behind the hocks, one on the lower back, one on each buttock, and one interdigital gland on each foot—eleven in all. But the lachrymal glands and sinus are absent, although often found in the Bovidæ. The buttock glands and the dorsal gland are not found on any of the Bovidæ that I know of. When the rump hair is raised or lowered a strong, musky odor is given out, and it is suggested by Dr. R. W. Shufeldt that the office of these many glands is to furnish an odor to protect the animals from the swarms of insects such as gnats, mosquitoes, and flies.

Prong-horns do not seek to elude observation, all they care about is to be able to see for themselves. Their habit of lying on a commanding knoll to give full scope to keen eyesight has already been spoken of; but they often take the opposite course and lie in a hollow to get out of a breeze, which they do not seem to like. They also are apt to face towards the wind to give their ears and noses the very best opportunity to detect the approach of an enemy. While ordinarily the color is a conspicuous one, still it has some protective value. I remember once seeing a stone the same color as an antelope, but when I got opposite to it, to my great surprise a big buck antelope jumped up. And I often have the opposite experience and have a prong-horn turn out to be a stone on closer examination!

These animals can swim when necessary, often fording swift and deep streams (on one occasion I saw a spring flood dashing high over a swimming prong-horn, which, although swept downstream at considerable speed, kept bravely on and finally got across), but I do not see them standing in water as deer and elk do, nor do I often see them bathing. In fording a stream, they do not stop to drink as elk usually do; and I notice that in every case antelopes have left the water on the run and have gone quite a distance before even stopping to shake themselves. Perhaps they do not like to risk being between the high banks that most of our streams have.

In their eating, prong-horns confine themselves largely to various grasses, preferably those like the gramma, buffalo, and bunch grasses that cure well on the stalk. They are also fond of alfalfa and will strip the heads from any vagrant oat stalks they find; but they cannot live on the rich, green grasses of the East. I have never seen any evidence of browsing on bushes and trees, except that they eat leaves

from the *tridentata* sage quite freely, even when forage is plentiful. Their hours for feeding are irregular, but when they are feeding, prong-horns crop their food for about an hour, then lie down and "chew the cud" for thirty to forty minutes before resuming grazing. I have never seen antelopes paw away the snow, as do deer and elk, nor have I ever found any spots so uncovered by them. The ones I have watched preferred to hunt a bare spot, or selected a thinly covered space where they could push the snow aside with their noses. Prong-horns are dainty eaters, picking out only the cleanest and best of the grasses; and avoid all stretches already grazed by domestic animals, especially sheep. When forage is good, they become fat and strong, and the kids develop much faster than during lean years. I believe, too, that horn growth is stronger and better after a good summer and autumn season. Prong-horns are fond of "soda licks," and at times take some of the salt put out for the buffaloes; in winter they often eat snow in preference to hunting up the scarcer open water. When they do seek water, they are as apt to do so at noon as at any other time of the day.

It is rather difficult to be positive on such a point, but all my notes seem to show that prong-horns are quieter during the night and not given to moving about nor eating so much as in daytime. Certainly they are less nocturnal than deer and elk. Quite often they spend the nights on hills and elevations, and move down to the valleys to feed in the morning.

The rutting season is in September and October, at which time antelopes are found in pairs and small groups of three, four, and five, but I see no evidence of the "harem" habit of the elk, where the male gathers together as many of the other sex as he can. Courtship seems to consist largely in swift running matches wherein the doe runs away from the buck, or suffers herself to be caught, as she sees fit; for she evidently is the speedier of the two. I am inclined to rate this animal very high on the score of family associations. It is true that prong-horns combine in large bands during the winter months for mutual protection, but about the first of February they disband into couples and small groups. All through the spring and summer I find couples and small family parties, with the bucks living peaceably with their wives and families. At times the buck on a knoll often mounts guard over them to prevent surprise while they feed quietly below. But it often happens that two rival bucks are found fighting during the mating season, and I have seen a small buck driven out of a small

band of does and kids by a larger and stronger buck. Usually the contests do not develop into a battle; the weaker animal gives up after a pass or two and is chased off by the victor. Where a fight does develop the two bucks come together head on, then each strains hard to push his rival back. After a minute or two, one suddenly springs away, turns, and is off like a shot with the other in hot pursuit for a half mile or more. At other seasons they seem even more peaceable, and I can only attribute the fact that almost every shed horn found is marked with scars, to the fact that the sheath is comparatively soft and that they are shed so soon after the rut is over.

The period of gestation is a little over eight months or slightly longer than with deer. Late in May, or early in June, the doe retires to some secluded spot and there the kids are born, usually two at a time. Compared with deer and elk of the same age, a prong-horn baby is unusually strong and reliant. True it trusts largely to hiding to escape its enemies, but if necessary, it can run quite fast. If the mother has any chance at all to fight for her youngsters, she will attack at once and fight with great intrepidity. She uses her sharp hoofs with fine effectiveness, striking a quick, downward blow with her fore feet that easily disables a coyote or similar foe. There being no rattlesnakes in the Yellowstone, I cannot confirm of my own knowledge that she can cut one to pieces before he can strike, but I do believe it probable. That the young are efficient in their fight for existence is shown by the number that survive the first year. In the spring of 1921, I found by careful count that almost 19 per cent of our herd were young ones approaching one year old, this figure being much higher than for our other large animals. I remember well a little fellow found one fourth of June; I did not see his twin until later, and the mother, not at all. He was unseen until I almost stepped on him; when he ran, he started at once at full speed, and so astonishing was his speed he seemed fairly to fade from sight into the misty rain that was falling. He was somewhat lighter in color than the adults, and with markings nowhere near as distinct, but his coat served him well, protectively, among the gray glacial boulders of his native bench land. Later I found his brother in the lee of one of these same boulders. Judging from what I have seen, new-born kids are capable of withstanding quite severe cold spells, and storms of snow and hail.

Sometimes I find old bucks off by themselves; but there are enough exceptions, so that I would not feel safe in saying either that hermitage was usual for the old fellows, or that it was not. As I have said before,

family parties are frequently seen in summer, and in winter prong-horns certainly are social and gregarious, all our animals gathering together in one or two large bands. As far as other species are concerned, they evidently prefer to be by themselves. I see no evidence of antagonism, but an antelope's disposition seems to be to avoid all other animals. Occasionally they are with deer, elk, mountain sheep, and even buffaloes, but the association is due to limited forage and not at all to sociability. The prong-horns always shy off from the larger animals, do not relish their proximity, and even go so far as to decline forage over which elk and domestic sheep, cattle, or horses have grazed. Two or three times I have seen them running from pursuing buffaloes and elk.

In addition to being peaceable and friendly among themselves, many of the antelopes get strangely tame and confiding towards us. In riding horseback along our roads, I have passed within twenty feet without disturbing them in the least. Yet they vary a good deal, and individuals that I marked one day as tame, were met the next day on migration and were extremely nervous and wild. In fact, I have found prong-horns much wilder and more suspicious on migration than at other times.

Timid as they are, prong-horns have such a developed sense of curiosity, that it serves them ill against man; in the case of their natural enemies, their matchless speed will usually carry them out of any danger their curiosity gets them into. Since the days of Lewis and Clark, hunters, taking a leaf from the Indians' method, have made use of a red flag to entice the curious animals within range of their rifles. Nor is it necessarily red, any color will do, the more conspicuous the better. If no flag is convenient, the hunter lies on his back and kicks one foot quickly up and down. In fact any strange object, or any strange motion, will do the trick.

On one occasion a buck prong-horn on a river bottom saw two elk coming down a hill a mile away, ran to and around them, and then back to where he had been originally. On another occasion, I got off my horse and left him to graze while I examined a bird-nest I had discovered. Soon a female antelope came up over a hill and spied the horse; immediately she began to display great curiosity, circling about, and gradually working nearer, but frequently whirling as quick as a flash, and away at full speed for a hundred feet, only to draw nearer once more. When a vagrant eddy of wind carried a scent of me to her, she was off in earnest and ran clear out of sight; but even then after a short stay, she was back again for another look!

On another day on the main road, I had a small male antelope come up to within a hundred feet to watch me ride past. As I did so, he squealed and stamped first one fore foot and then the other, and then trotted up and crossed the road in front of my horse. On another occasion I approached a group of twelve animals standing on a knoll. Most of them moved off, leaving one that permitted me to pass within fifty feet. After I had passed he started suddenly to run and was almost instantly at full speed and seemed to grow more and more frightened the farther he ran.

Such occurrences are common enough almost daily; and when we are in camp on the prong-horn range, we so often have a single animal, or even a group of three or four, come up to inspect camp and stay about for some time, that it arouses little comment. Where blinds are built for photographic purposes, they usually result in attracting, sooner or later, most of the antelopes in the vicinity. My experience has been that single animals are more apt to show this inordinate curiosity, still I have had considerable bands come close to my blind at times.

Naturally the broad open plains on which the prong-horns live, and the fact that they depend more on eyesight and their sense of smell, make calls and sounds more or less superfluous and create the necessity for other signals. They have an alarm note that might be described as either a squeal or a bark, and they use it when curious as well as when alarmed. But one of the great characteristics of this animal is its "signalling" with its rump patch, whose dazzling white hairs can be erected or depressed at will. In times of excitement, alarm, and pain, these patches are erected, forming two "great chrysanthemum-like white rosettes," as Dr. E. W. Nelson expresses it, that instantly attract attention and can be seen for a long distance. The prong-horn, first giving the signal, turns so that all his companions can see it, sometimes it is constant and sometimes the alternate raising and lowering gives a quick series of flashes. A second animal seeing the signal, repeats and the alarm is flashed from point to point across the plains as if from a series of heliograph stations. Then all the animals run together into a small, compact band, if it is at all possible. As they dash away, the white signals can be seen for a long distance; as the animals halt and face about, the signals disappear and the otherwise neutral color causes the animals to fade out as by magic. But if there is still cause for alarm, the white signals flash out again and again long after the rest of the animal has become invisible. Upon investigation it is found that there is a mass of muscle underlying the buttock patches and glands

and all interconnected. As soon as the animal is excited these muscles act, perhaps involuntarily, the hairs are raised and the glands are exposed, releasing a musky odor noticeable to man's poor nose for quite a distance, especially down wind. No doubt the superior nose of an antelope can detect it a mile away on open ground. Has this animal, perhaps, a second odor meaning that the exciting cause is ended, or that it is not dangerous?

In captivity antelopes are trustful, affectionate, and fond of being noticed; very playful when young, their growing strength soon makes them too rough for human companionship although I have yet to hear of one that became actually vicious. They like to follow people about, but apparently never lose their extreme nervousness; even a dislodged pebble being sufficient to put them to flight in terror, although they soon come back again. At such times the youngster, that may never have seen an adult do it, will instinctively "flash" his signal. The usual run of dogs bother little even a very young antelope, which has no difficulty in outrunning a pack of them.

Unfortunately, prong-horns are very hard to keep in parks and zoological gardens, and indeed anywhere off the great, dry, open ranges that produced them. The superintendent of one of our zoological gardens writes me that out of thirty-two specimens only a few lived over one year, and that their best record was one that lived five years. I have heard of only two or three instances where young have been born in captivity and they did not live long in any case. Antelopes seem very susceptible to diseases and especially parasites of one kind or another. Their food must be carefully chosen for they do not live on a diet of rich green grass. A ration of rolled oats, clover, and a very little grass, with a little salt two or three times a week, has given the best results. But in addition to these difficulties, the great trouble seems to lie in the extreme timidity and nervousness that gives a captive so little rest and tranquility.

In common with other animals, their life on the broad open ranges keeps them comparatively free of diseases; practically all of their troubles of this kind being due to infection from domestic sheep, cattle, and horses.

Prong-horns in captivity suffer from pneumonia, malignant catarrh, pyemia, congestion of the lungs, and ulcers; most of these are climatic diseases and have not been serious among our Yellowstone animals. But with actinomycosis, or lumpy-jaw, the case is different. Some of our elk, deer, and antelopes have died from this disease; and in the

case of the last animal, the disease is particularly virulent, and few, if any, recover from an infection.

Internal parasites are of several kinds that infest domestic sheep, goats, and cattle—tape worms, stomach worms, whip worms, and hair worms. There is also a tape worm found in foxes, wolves, and coyotes, which in the embryo stage is found in our antelope.

External parasites that we must guard against are the wood tick and the scab mite; both of which are dangerous because of debilitating effect on the victim.

For approximately three months, from about the first of November, prong-horns gather together in large bands for mutual protection. This period corresponds with the growing season of the bucks' horns, when they are least able to defend themselves. It is interesting to observe that during these three months, the bands are led by the does although there may be several full-grown bucks present. More than once I have seen a band, when climbing a low elevation, stop before it reached the crest, permitting the leading doe to run up and look over to examine the country ahead for some minutes before she returned to lead the band up and over. Prong-horns are usually watchful enough to prevent the close approach of an enemy, for it is their rule to occupy good lookout positions, and they frequently have sentinels posted whose only duty is to watch while the rest feed.

Coyotes, especially when banded together in packs, are the most dangerous of the antelope's enemies. Even so, I do not believe they catch many of the healthy adults, although a few of the old and diseased animals fall victims. Undoubtedly the coyotes cause additional damage by worrying them, and keeping the nervous animals stirred up and excited. The gray, or timber, wolves kill a few antelopes, although as a rule they confine their attacks to larger and slower animals. Owing to the peculiar rough and broken character of our winter range, affording good lurking places, the mountain lions manage to kill a few under exceptionally favorable circumstances. I doubt if a bear can catch a prong-horn unless he finds a very young kid hiding. Buffaloes occasionally kill very small kids, but as a rule, even the youngest are speedy enough to escape. The only birds I can think of as possibly dangerous, are the great golden eagles; there I should say the danger was small because other game, during the extreme youth of the kids, would be easier to get.

It is extremely difficult to determine how long antelopes live. They reach maturity at five, and, as a rule, live from three to five years

longer, although at times an individual reaches the ripe old age of twelve or fifteen years.

Dr. R. W. Shufeldt tells of an unusual animal seen six miles north of old Fort Fetterman, in Wyoming. Of a band of nine antelope in a shallow valley

the largest buck, a full-grown and splendid specimen, had jet black head and shoulders, while the coloration of the rest of his body was normal. A case of melanism of an antelope—where the condition was confined to the head and shoulders—must certainly be one of the rarest occurrences in nature.

Although the great abundance of the antelope in the old days made sure an ample supply of meat for the use of the hunters, red and white, the quality of this meat, which is described by one authority as "delicious" and by another as "highly relished by everyone who has ever partaken of it," only served later to hasten the destruction of the animal. The secretion from the glands, although strong and musky, does not affect the flesh in any way. Until late in the 70's the Indians on the plains depended to no little extent on the antelope for meat, especially when deer, elk, and prairie-dogs could not be obtained.

Dr. E. W. Nelson says:

In 1884 antelope still existed in large numbers at many points in the Rocky Mountains from near the Mexican to the Canadian border. We killed antelope, deer, or elk for ranch use throughout the year without a thought that the supply was not perpetual.

And Col. Theodore Roosevelt has written, "On my ranch it has always been the animal which yielded us most of the fresh meat in the spring and summer."

I have already related how hunters, Indians as well as white men, made use of the antelope's great curiosity to lure them to destruction by waving a red shirt, a bit of colored cloth, or other unusual but plainly seen object. But the Indians had other methods of hunting. It is known that they sometimes surrounded a herd, driving it into the water where the game could be easily slaughtered with arrows. Some of the tribes who had plenty of horses in suitable country, sometimes ran antelopes down by using relays of riders previously posted about a small band. It must be admitted though, that this method was very unproductive of results, often requiring a day's hard work on the part of twenty Indians and horses to secure one or two hundred pounds of meat.

But there was another method much more productive, and used by widely separated tribes. In his Snake Dance of the Moquis, Capt. John G. Burke gives the following:

We passed, near the Hopi villages in northeast Arizona, close to an antelope "corral" of the Navahos. These are made of two converging lines of stone and brush. The Navaho warriors, mounting their fleetest ponies, will scour the country for miles, driving before them the luckless game, which after a while reaches the narrowest point of the corral and then falls a victim to the hunters in ambush. The Indians are careful not to kill all, but to allow a few to escape. This forbearance is partly based upon a desire to allow the game to reproduce, and is partly religious in character.

And in the Lewis and Clark report:

A camp of Mandans caught within two days one hundred goats [prong-horn] a short distance below us. Their mode of hunting them is to form a large strong pen or fold, from which a fence, made of bushes, gradually widens on each side: the animals are surrounded by the hunters, and gently driven towards this pen, in which they imperceptibly find themselves enclosed, and are then at the mercy of the hunters.

This same method was used in the upper Yellowstone country by the Crows and Blackfeet. Even now there is the remains of an old "corral" essentially as described, near Reese Creek, three miles north of the northern boundary, and another near Emigrant, Montana, thirty miles farther north.

Perhaps another reason for the destruction of these beautiful animals was that they could be hunted at all times of the day, even during the noon-day hours when it was almost useless to try for deer and elk. On the other hand, antelopes were not only shy and wary and hard to approach, but they were also hard to kill. Colonel Roosevelt has stated that it was astonishing how fast a wounded animal, even when a leg was broken, could run unless given a more crippling wound. Even after having fallen, antelopes have been known to get up, throw off the hunters that may have laid hands on them, and escape. In contrast to the desirability of the meat the hides, either dressed as fur or tanned into leather, were not highly valued.

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BUCK PRONG-HORNS, JANUARY 20, AT A TIME WHEN THE HORNS ARE ABOUT
HALF FORMED

An examination will show the hard upper half, with the bristly hairs extending up from below. The lower picture shows the standing buck with "signal" raised.

(Skinner: The Prong-horn)



SHED HORNS FROM A THREE YEAR OLD AND A FIVE YEAR OLD BUCK

Both show the short curly hairs at base. The smaller horn also shows the start of two additional prongs below the main prong.



PRONG-HORN SHEATH, JUST SHED

Note the short white hair curling up from base. The roughness between base and prong is probably due to injury when fighting.

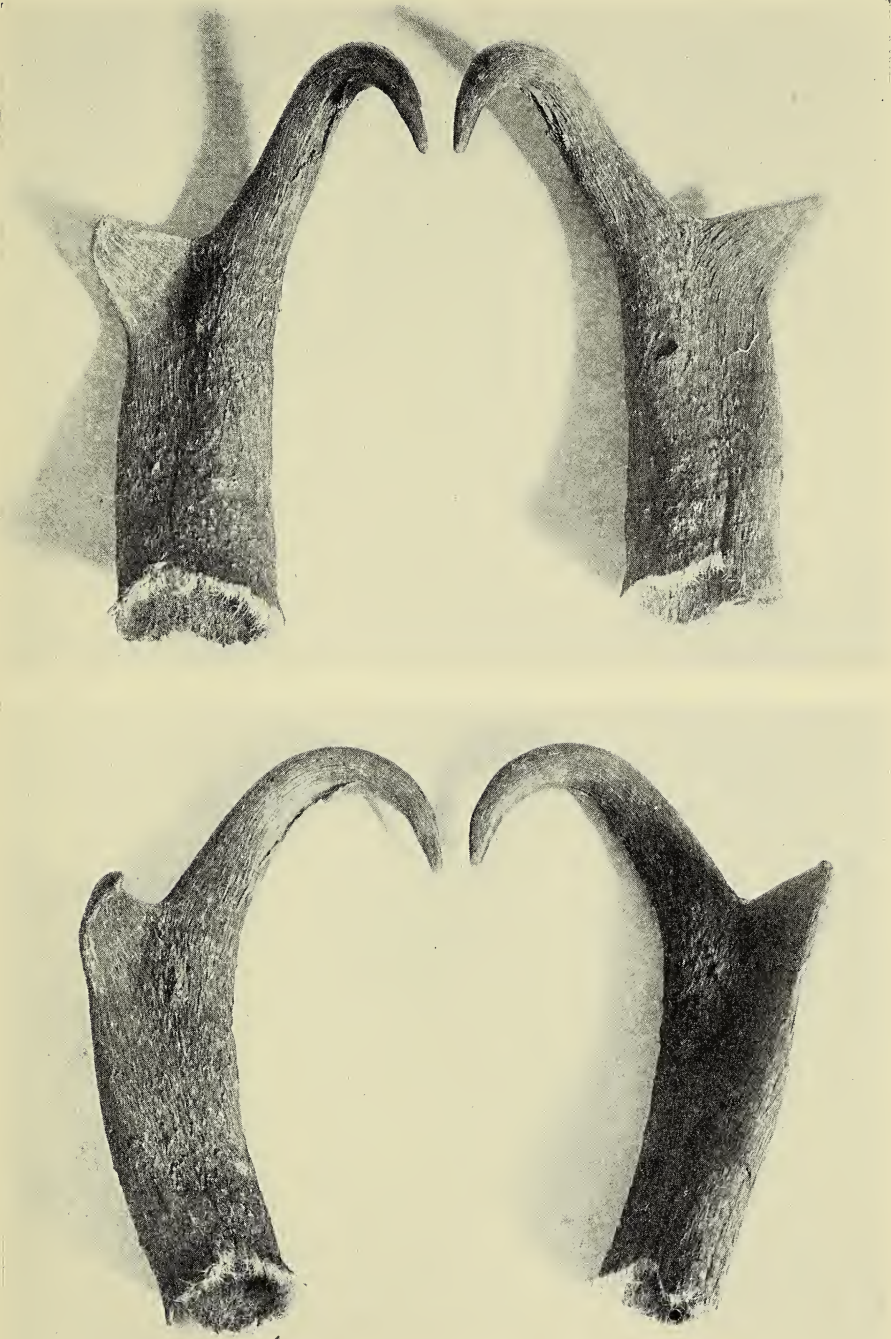
(Skinner: The Prong-horn)



SHED HORNS SHOWING PROGRESS OF DESTRUCTION

The horn on left was freshly shed; the next had been shed about five months; the next about seventeen months; and the one at extreme right also seventeen months, but had fallen in a place suitable to more rapid destruction.

(Skinner: The Prong-horn)



THE ONLY TRUE PAIR OF SHED HORNS FOUND BY AUTHOR

The injuries inside both tips are typical fighting scars. In the lower figure the horns are turned to show the natural front view.

(Skinner: The Prong-horn)

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Yellowstone National Park, Wyoming.

ON THE "HABITUS" AND "HERITAGE" OF *CÆNOLESTES*

BY WILLIAM K. GREGORY

The more closely one studies Dr. W. H. Osgood's excellent monograph on *Cænolestes*¹ the more one must be grateful to him for the quality and range of his plates, for the thoroughness of his comparisons (within the limits of available material) and for his eminently fair and impartial presentation and analysis of the difficult subject of the precise relationships of that animal to other marsupials. Doctor Osgood's monograph has already been reviewed in a recent number of this journal² and I have no wish to offer detailed criticisms or to challenge the author's main conclusions. But a careful study of this work and of Lönnberg's recent brief paper³ has resulted in the following preliminary and partial analysis, in which an attempt is made, first, to bring out the correlation of habit and structure, and secondly, to make a beginning towards separating those features which have been acquired during the present life habits (*habitus*) from those which have been inherited from previous life habits (*heritage*).⁴ Unless otherwise noted the statements of anatomical fact are to be credited to Osgood.

I. LIFE HABITS AND ECOLOGY

1. *Geographic Distribution.* Present: Andes of Venezuela, Colombia, Ecuador, Peru. Past: *Cænolestes* is a survivor of the Santa Cruz Miocene Epanorthidæ (Palæothentidæ) of Patagonia.

2. *Life Zone.* Cool, dense forests at high altitude, 6 to 12 thousand feet, near timber line. Also in grassy openings of mountain valleys. *Cænolestes* lives in dense growth, beneath the canopy of the tree tops and still further shaded by masses of low vegetation. Osgood infers that it is crepuscular or nocturnal in habits. Found in runways among the thick grass in swampy ground, about on a level with the water line of the swamp. Lönnberg (1921) says it is arboreal in habits, but this seems doubtful.

¹ A Monographic Study of the American Marsupial, *Cænolestes*. Field Mus. Nat. Hist., Zoöl. Ser., vol. 14, no. 1, pp. 1-162, May, 1921.

² Journ. Mammal., vol. 2, no. 4, pp. 241, Nov., 1921.

³ A Second Contribution to the Mammalogy of Ecuador, with some remarks on *Cænolestes*. Arkiv. f. Zoöl., Bd. 14, no. 4, pp. 1-104, 1921.

⁴ Gregory, 1913. Locomotive Adaptations in Fishes, Illustrating "Habitus" and "Heritage." Ann. N. Y. Acad. Sci., pp. 267-268; Osborn, 1917. Heritage and Habitus, Science, N. S., vol. xlv, no. 1174, pp. 560-561.

3. *Food Habits.* Examination of three stomach contents reveals remains of weevils, caterpillars, lepidopterous pupa, adult lepidopteran, leg fragments of orthopteran, tipulid larva, centipede, spider. Dip-terous and lepidopterous remains form the major portion (in one case 60 per cent). Animals caught in traps showed preference for meat bait. Nothing known directly of methods of catching food, but there is much anatomical evidence which will be discussed below.

4. *Locomotor habits.* Only definite fact of field observation is that animals move about freely and are terrestrial, often going through runways. Much anatomical evidence.

5. *Protective habits and reactions.* No direct testimony.

6. *Breeding habits.* Ditto.

II. HABITUS AND HERITAGE OF THE FOOD-GETTING AND FOOD-REDUCING SYSTEMS

A. *Habitus*

The food habitus involves primarily the organs of detection, prehension, occlusion, mastication, deglutition, ingestion, digestion, assimilation, circulation and excretion. It involves secondarily other systems, such as the locomotor and the controlling or nervous, adjusting systems.

Cænolestes feeds on insects by means of the following adaptive characteristics:

1. *Organs of detection.*

a. *Sight* poor. Eyes small, orbits small, optic nerves and foramina and nerves of eye-muscles all small.

b. *Smell* very highly developed. Very large olfactory bulbs and tuberculum olfactorium. Chiefly an olfactory brain. Large olfactory fossa in braincase and large snout. Expanded olfactory chamber with four large ethmoturbinals and one nasoturbinal.

c. *Touch.* Sensory vibrissæ on snout and cheeks. Very large superior maxillary branch of fifth nerve for nose and lips.

d. *Hearing* acute. Very large external ears and large inner ear.

2. *Organs of prehension and occlusion.*

a. *Prehension.* Orbicularis oris and buccinator muscles well developed. Maxillo-labialis or levator muscles of lips rather weak. Labrets on upper and lower lips recall those of kangaroos. May be used for holding or ejecting food? Tongue long, fleshy, pointed, under surface sharply keeled, the keel extending beyond the tip of the tongue, fitting into the interspace between the two long anterior incisors. It represents the median portion of the sub-lingua (Lönnberg).

b. *Prehension and occlusion.* Upper and lower incisors remarkably kangaroo-like for prehension and cutting. Large papilla incisiva, also kangaroo-like. Opposes lower incisors. Incisor arrangement functionally more or less shrew-like. Palatal ridges closely resembling those of the Macropodidæ and *Eudromicia* among the Phalangeridæ (Lönnberg). Upper premolars small, pointed; coöperate with small lower incisors and lower premolars to kill insects.

3. *Organs of mastication.*

a. Upper and lower molars (Fig. 1. Description by present writer): m_1 - m_3 tuberculosectorial, with expanded posterior V and large talonid basin. The large talonid implies a large protocone in the upper molars;

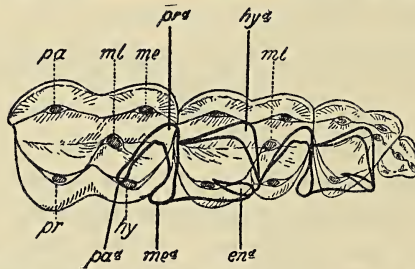


FIG. 1. DIAGRAM SHOWING OCCLUSAL RELATIONS OF THE PARTS OF THE UPPER AND LOWER MOLARS.

The metacone (*me*) and metaconule (*ml*) of the upper molars have their normal spatial relations with the parts of the lower teeth.

UPPER MOLARS		LOWER MOLARS	
<i>pr</i> , protocone	<i>Trigonid</i>	<i>Talonid</i>	
<i>pa</i> , paracone	<i>pr</i> ^d , protoconid	<i>hy</i> ^d , hypoconid	
<i>me</i> , metacone	<i>pa</i> ^d , paraconid	<i>en</i> ^d , entoconid	
<i>ml</i> , metaconule	<i>me</i> ^d , metaconid		
<i>hy</i> , hypocone			

the greater transverse width of the talonid as compared with the trigonid invariably implies that the para- and metacones are well separated. The fact that the trigonid basin is well above the level of the talonid basin implies that the protocone is higher than the hypocone. The marked anteroposterior length of the first three lower molars implies a corresponding lengthening of the upper molars.

There is practically no trigonid basin in the fourth lower molar and so there should be, and indeed there is, no hypocone on the third upper molar. The enlarged entoconid of m_{1-3} fits lingually between the proto- and the hypocone.

The metaconule (*ml*) of the upper molars furnishes an additional cutting blade that works between the hypoconid of one lower molar and

the protoconid of the one behind it. Doctor Osgood suggests that this small cusp may represent a reduced metacone and that the two main outer cusps are derived from the styles; but, as shown in Fig. 1, the two main outer cusps have practically the normal occlusal relations of para- and metacones, while the stylar cusps of *Perameles* are here represented by the external cingulum. All this arrangement of shearing blades would be well adapted for cutting and dividing the chitinous bodies of insects.

The fourth upper and lower molars are reduced in size precisely because the first three are enlarged and because there was no room for expansion backward without encroachment upon the space filled by the strong jaw muscles.

b. *Jaws.* Jaw movements (as inferred from experiments with skulls and mandibles) remind one somewhat of those of herbivores, perhaps because chitinous bodies may be somewhat like grass stems in cutting properties. As shown in American Museum specimens of *Cænolestes*, the lower molars move from below, upward, forward and inward. In using the tip of the lower central incisor the animal brings the condyle forward to the front part of the smooth glenoid; the dorsal edge of the long lower incisor shears past the compressed second and third upper incisors.

Jaw muscles recall artiodactyls and especially kangaroos; but the most exceptional feature is the large size of the external pterygoid which is two-fifths the size of the internal pterygoid and double-headed, inserting at base of mandibular condyle and on stylomandibular ligament. Possibly associated with forward oblique pressure of lower molars on upper.

Bony jaws: upper jaw (including zygoma) on the whole rather more slender than in primitive insectivores; lower jaw with large areas for masseter and internal pterygoid muscles.

4. *Organs of deglutition and digestion.*

- a. Parotid and submaxillary glands very large.
- b. Throat muscles apparently primitive and normal.
- c. Stomach with strongly differentiated glandular area forming a compound gastric gland, comparable in part to *Phascolarctos*, *Phascolomys*, and *Manis*. Stomach unique.
- d. Large intestine relatively short.
- e. Colon short, with very small cæcum.
- f. Liver relatively large.
- g. Pancreas extensive.

B. Heritage

Accepting the views of Huxley, Dollo, Bensley, Osgood and others that the existing Didelphidæ stand near the center of the adaptive radiation of the marsupials (a view endorsed by Matthew, 1913, on palæontological grounds) we find that in its nutritional habitus *Cænolestes* is almost intermediate between the primitive insectivorous polyprotodonts and the more primitive Australian diprotodonts, such as *Distæchurus* of the Phalangeridæ. Thus in the dentition it inherits from the polyprotodonts the primitive dental formula, the tuberculo-sectorial character of the lower molars, the remnants of trituberculy in the upper molars, and of the external cingula in both the upper and the lower molars. On the other hand *Cænolestes* has advanced in the direction of the diprotodonts in acquiring fully developed diprotodonty of the front teeth, and a remarkably kangaroo-like papilla incisiva, while the upper and lower molars approach the pattern of those of the smaller phalangers. But neither in *Cænolestes* nor in any of its known extinct relatives is the dentition as a whole sufficiently close to those of Australian diprotodonts to warrant us in referring them to any given Australian family. In comparison with that of *Perameles*, the dentition of *Cænolestes* differs radically; for the former may best be derived as by Bensley (Pls. 5, 6) from some small polyprotodont, such as *Peratherium*, with inwardly grown para- and metacones and heavily developed buccal styler cusps. In the Peramelidæ the dentition, while remaining polyprotodont in front, has become hyposodont in the cheek teeth, while *Cænolestes* has acquired diprotodonty in the front teeth and incipient lophodonty in the cheek teeth. In brief, as regards its dentition, *Cænolestes* and the whole family of Palæothentidæ may represent an independent group not directly ancestral to any Australian diprotodont, but lying between the Peramelidæ and the Phalangeridæ, as suggested by Osgood.

In respect of the organs used in detecting the food, *Cænolestes* may well represent a secondary specialization in the excessive size of its olfactory, tactile and auditory organs and in the reduction of the sense of sight which is fairly well developed in the smaller Didelphidæ.

With regard to the stomach, which is peculiarly specialized, Osgood remarks (p. 72) that this organ is unique and serves to strengthen the general conclusion that the animal stands by itself quite as independently as any of the highly specialized Australian forms. Osgood also remarks (p. 78) that the short colon combined with the small cæcum in *Cænolestes* is contrary to the usual condition in marsupials and is

most nearly met in certain of the dasyures, and that although the short colon is perhaps primitive, the small cæcum is obviously a secondary condition.

In brief, to judge from its nutritional habitus as a whole, one might infer (as Doctor Osgood does) that *Cænolestes* is a descendant of that part of the primitive polyprotodont group which gave rise both to the Peramelidæ and to the Australian diprotodonts.

III. HABITUS AND HERITAGE OF THE LOCOMOTOR APPARATUS

A. Habitus

The locomotor habitus involves primarily the locomotor system of nerves, muscles, connective tissue, ligaments, axial and appendicular skeleton. It is supported of course by the activities of the food habitus and is controlled by the nervous system. It subserves the needs of the protective, nutritional and reproductive systems.

Among other significant facts regarding the skeleton as a whole are the following: the head is decidedly long in proportion to the size of the thorax, as in insectivores, and in contrast with most ungulates, in which the head is comparatively small. The thorax is relatively small, perhaps because the food is highly nutritious, and especially because a small animal needs relatively far less food than a large one. The locomotor skeleton must therefore be adapted to the support and propulsion of a large head and a relatively light thorax. Accordingly we find that the backbone has the cervical vertebræ quite short, with a very large lumen for the spinal cord, that the dorsal and lumbar and more proximal tail vertebræ are large, as are also the chief muscles of the back.

Limbs and feet. The most conspicuous and easily interpreted parts of the locomotor habitus are usually the extremities. In *Cænolestes* the pes presents a general development similar to that of *Phascogale* in so far as it has a reduced clawless hallux and is rather narrow, with four sub-equal clawed digits. Such a foot is of the sub-cursorial rather than arboreal type, as indicated also in the skeleton of the foot, the astragalus, for instance, being somewhat intermediate between that of the pedimanous marsupials and that of the highly saltatorial forms (Osgood, p. 95). In this connection Osgood notes (p. 60) that "the muscles of the legs and feet in *Cænolestes* are adapted to a terrestrial, almost cursorial life. The leg muscles have short, thick, fleshy parts and very long tendinous extensions, relatively longer even than in such terrestrial

forms as *Phascogale*, and in this respect are perhaps most similar to those of the saltatorial but otherwise generalized Australian polyprotodont *Antechinomys*, the myology of which has not been thoroughly described. The proportion of tendinous to fleshy parts is about as 60 is to 40 and the outline of the leg thus resembles that of a digitigrade animal. It is markedly different from that of *Didelphis*, in which fleshy extensions reach nearly or quite to the carpus and tarsus. Specialization for terrestrial life has proceeded far beyond that in *Peramys*, whose habits are presumably not greatly different from those of *Cænolestes* but whose musculature is only slightly different from that of *Didelphis*. . . . There is some reduction of the intrinsic muscles of the feet, especially in the adductor sets, and the grasping power is distinctly limited." On the other hand we have the opinion of Lönnberg, expressed as follows: "As already known, *Cænolestes* has arboreal habits. Its feet with their naked, warty soles and the well developed pads must be useful in climbing, but the fore feet undoubtedly exhibit more pronounced adaptations to the arboreal life. The reduction of the claws on the first and fifth finger to nails and the displacement of the latter in direction towards the carpus must be interpreted as such adaptations. Although neither the pollex nor the fifth finger are directly opposable, they are certainly more free in their movements than the corresponding fingers in f. i. *Phascogale* or some other primitive marsupial. They serve therefore without doubt as useful grasping organs, and the fifth finger appears to do so even in a higher degree than the pollex itself, to judge from the fact that it is more powerful and has a better developed pad at its base."

In brief, if *Cænolestes* can climb trees at all it does so not by means of the primary arboreal habitus of the Didelphidæ and Australian diprotodonts, which have well developed divergent hallux and pollux, but by a secondary arboreal adaptation involving sharply curved claws on the middle three digits of both manus and pes, with strong, deep flexors of the digits and partly divergent pollex and minimus in the manus. On the other hand, it is perhaps more probable that the strong claws on the hands and feet may be used in scratching for insects on the ground. Taken as a whole the limbs and feet resemble those of rats and insectivores, especially in such particulars as the bowing of the tibia upon the fibula, and of the radius on the ulna, with the reduction of free movement in both cases.

Important indications concerning the method of locomotion are afforded by the following data supplied by Osgood: In *Cænolestes* the

tibia is very long, the femur being only 63.5 per cent as long as the tibia, i.e., nearly as long as in the saltatorial *Macropus giganteus* in which the femur falls to 57 per cent of the length of the tibia. This contrasts with *Perameles nasuta* in which the femur is 94.3 per cent of the length of the tibia, and still more with *Sarcophilus*, *Trichosurus*, *Phascalomys* and *Phascolarctos*, in which the percentage rises rapidly from 100 to 134.

Other indications of cursorial or partly saltatorial modes of locomotion may be found in the large size of the lumbar vertebræ, which have well-developed, forwardly-directed parapophyses, in the length of the tail and large size of the caudal centra and chevrons, in the fact that the ilium is nearly parallel with the sacral portion of the column as in the kangaroos. There is a distinct so-called center of motion located in an anticlinal vertebra, in the posterior dorsal region, as in *Dasyuridæ*, *Macropodidæ* and other terrestrial or leaping forms, and in contrast with the primitive arboreal *Didelphidæ* in which there is practically no anticlinal vertebra.

In brief, the evidence for cursorial and probably in part saltatorial habits seems fairly conclusive, but it is also barely possible that these small and very active animals run up the trunks and branches of trees.

B. Heritage

That *Cænolestes* has been derived eventually from *Didelphis*-like arboreal forms, in accordance with the views of Dollo and Bensley with regard to marsupials as a whole, is evidenced by the occurrence of many primitive marsupial characters in the locomotor apparatus, such as are found in the *Didelphidæ* in association with arboreal habits. Even the hands and feet retain evidences of ultimate derivation from a *Didelphis*-like prototype. In the pes perhaps the closest resemblances are to be found in *Phascogale*, but although the underlying pattern is similar, a significant difference is seen in the larger size of the volar pads in *Cænolestes*, which is possibly associated with a scratching or scraping action of the feet.

In the postcranial skeleton of *Cænolestes* Osgood (p. 98) notes a number of peculiar or unique characters which perhaps collectively indicate a long separation from other families of marsupials. Even the resemblances to others are distributed in such a way and are accompanied by so many differences that *Cænolestes* cannot easily be made to fit in either with the *Polyprotodontia* or the *Diprotodontia*. On the whole, the postcranial skeleton suggests a nearer relationship with

Australian marsupials of both divisions than with the Didelphidæ. There are also certain special resemblances to the Peramelidæ (Osgood, p. 150) which, taken in connection with other evidence, leads Doctor Osgood to place the *cænolestids* next to that family.

IV. HABITUS AND HERITAGE OF THE REPRODUCTIVE SYSTEM

With regard to the male generative organs of *Cænolestes* Doctor Osgood states (p. 65) that the most noteworthy features are the extraordinary size of the prostate and Cowper's glands, the very deeply cleft glans penis and the absence or great reduction of the levator penis muscle. The bifid glans penis occurs in both polyprotodonts and diprotodonts, and affords no definite evidence of relationship, and the other features also are difficult to interpret.

From the comparative standpoint the female reproductive organs, Doctor Osgood concludes, are more significant than those of the male. They are distinctly of a diprotodont rather than a polyprotodont type. This is evidenced by the deep median vaginæ and the long lateral vaginæ, and Doctor Osgood concludes that so far as gross examination indicates, parturition may take place by a short cut through a secondarily developed direct median passage, as in *Perameles* and the Macropodidæ.

The accessory reproductive characters of the female also afford some slight evidence of relationship with Australian forms, since there are four mammæ, as in many Australian genera, in contrast with the much higher number (up to twenty-seven) in the Didelphidæ. But the excessively high birth rate may be one of the features to which the Didelphidæ owe their survival, and it may therefore be a specialization in that family. On the whole, in the characters of the reproductive system *Cænolestes* shows a closer resemblance with Australian than with known Holarctic forms.

In conclusion, although the zoögeographic bearings of these facts have already been carefully considered by Doctor Osgood, it is to be hoped that he and other specially qualified authorities will further develop the true significance of these Australian-like characters in a South American family.

American Museum of Natural History, New York City.

GENERAL NOTES

ANOTHER OPOSSUM TAKEN IN VERMONT

In the May, 1921, issue of the Journal of Mammalogy the writer recorded the taking of an opossum at East Dorset, Vermont, the previous December. Another of the animals, a large male, was captured in a fox trap late in October, 1921, at Mount Horrid in Rochester, Vermont, by Dexter W. Kathan of Putney, Vermont. The second animal was taken about 45 miles north of the scene of the first capture. Both opossums had withstood considerable cold weather and snow. How they got into northern New England is an unsolved mystery, as inquiry in many sources has failed to disclose any one who has had them in captivity.—GEORGE L. KIRK, *Rutland, Vermont.*

SOME HABITS OF THE PRAIRIE MOLE, *SCALOPUS AQUATICUS MACHRINUS*

The prairie mole (*Scalopus aquaticus machrinus*) is not uncommon along the Mississippi and lower Wisconsin Rivers in southwestern Wisconsin, where it particularly favors the more sandy bottomlands above high water. At a place known as White City Resort, which lies about $1\frac{1}{2}$ miles north of the Illinois-Wisconsin boundary, and almost directly across the Mississippi from the most northerly parts of the city of Dubuque, Iowa, one was trapped in a Nash mole-trap the evening of August 5, 1920. Only a portion of the skin of the flank of the mole was caught in the trap, so the animal was practically uninjured, and I was able to keep him alive and make a few observations on his habits until the next morning, when it became necessary to prepare him for preservation in the U. S. Biological Survey Collection.

The mole exhibited all the strength accredited to his tribe. The cover of my heavy field telescope weighed probably 10 pounds, yet he easily moved it with his powerful fore legs when crowding between it and the wall. His efforts were always to dig down, or follow along the edge of a board, or under some object. Contact over his entire back seemed in a measure to answer the purpose of his runway, but contact on only a small part of his back acted as an irritant. I laid a mattress on the floor and he took particular delight in "digging under" it. He would raise the mattress and crawl its entire length; and under this mattress was his favorite resting place. I put him in a sink and he seemed particularly attracted to the drain holes, placing his nose first in one little circular opening, then in another, and at times resting for 15 or 20 minutes with his nose in one of the little holes in the drain-pipe sieve. His method of defense was mostly by pushing away the offender with his powerful fore feet, and, in his efforts to accomplish this, he would frequently follow the point of attack around over his back, and roll entirely over. He would, of course, use his teeth occasionally, but not persistently. He did not care for raisins, bat flesh, or cucumber rind, but ate a few cracker crumbs, and especially relished uncooked rolled oats, of which he ate what seemed a prodigious amount for such a small mammal. While he was eating, his proboscis-like nose came into play, it being used to locate each grain of oatmeal and to draw the food into the mouth, not unlike the way an elephant would use its trunk.—HARTLEY H. T. JACKSON, *U. S. Biological Survey, Washington, D. C.*

A BAT NEW FOR CALIFORNIA

Through the courtesy of H. E. Wilder, two specimens of *Corynorhinus rafinesquii townsendii* (Cooper) have come into my possession. They are Nos. FX 18 and GX 54 of my collection. Both are males, the first taken April 14, 1918, and the second taken August 3, 1919, at Carlotta, Humboldt County, California, by Mr. Wilder. Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology, has been good enough to examine these specimens and concurs in the subspecific determination. This form has not, I believe, been hitherto detected within the confines of California.—DONALD R. DICKEY, *Pasadena, California*.

A CORRECTION

In the November issue of this magazine (Journ. Mamm., vol. 2, p. 234) I referred a mongoose from Kentucky to *Herpestes griseus* E. Geoffroy. In doing so I had compared the Kentucky animal with specimens from the West Indies previously identified as *griseus*. Dr. Glover M. Allen has very kindly called to my attention that the mongoose now so common in certain of the West Indies is not *H. griseus*, but *H. birmanicus*. More careful examination of the specimens from the West Indies used as the comparative material shows that they are *birmanicus*. The mongoose from Kentucky should therefore be referred to *Herpestes birmanicus* Thomas.—HARTLEY H. T. JACKSON, *Biological Survey: Washington, D. C.*

A BROWN RAT KILLS A RATTLER

The following observation on *Rattus norvegicus* was made by two friends of the writer, Messrs. Martin and Otting, at their camp on the Colorado River above Austin, Texas, July 15, 1921, and would seem to deserve record in this Journal.

In the middle of the hot afternoon the rat was seen in the short, dry grass some twenty feet from the tent. Instead of scampering for cover as usual at the slightest sound emanating from human presence, the rat engaged in peculiar antics which attracted further attention. Closer inspection disclosed the fact that a mortal combat was in progress between the rat and a two-foot rattlesnake. Curiously enough, a second rat sat nearby so intent upon the rattler that it, too, was entirely oblivious of extraneous noises.

When first seen the serpent had already received two wounds some eight or ten inches from the tip of the tail, apparently through the backbone, for the caudal extremity was paralyzed. The rattler struck repeatedly at the rat, sometimes missing because of the agility of the latter, sometimes knocking it over on its side, but never closing upon it with its fangs. Occasionally the rat would leap over the snake's head and inflict skin wounds upon its antagonist. Finally, after about ten minutes of this give-and-take fight, in which the rat panted tremendously in the broiling sun, the rattler drooped its head for a moment as if to rest; whereupon the rat leaped upon the snake like a flash and won the battle by a single gash of its sharp incisors into its head, the snake wilting instantly. The rat was then dispatched with a shotgun. The snake was a diamond rattler (*Crotalus atrox*) and had two rattles and a "button."

A similar incident was related by Mr. Chas. H. Hamby concerning the prairie brush rat (doubtless *Neotoma*) which gathers large mounds of sticks, grass, dry cow-dung and the like for its nest. Sometimes possession of the nest is successfully disputed by rattlesnakes, which formerly infested the Driscoll Ranch (now in cultivation) 25 miles southeast of Austin, where the observation was made. Mr. Hamby describes the rat as the chief aggressor in the battle witnessed by him. The snake never struck, but confined its activities chiefly to attempts at escaping. It would coil up while the rat would stalk round and round until a favorable opportunity presented itself when the rat would pounce upon the coiled mass and bite furiously. Thereupon the snake would attempt to escape only to coil up again for defense. This procedure was repeated until the snake collapsed; and even after this the rat bit the snake a dozen times before leaving the field of battle. During the fight both snake and rat seemed perfectly oblivious of the observer's presence.

Doubtless the ferocity of the brown rat is a character which makes for its survival and spread, as contrasted with its competitors. Perhaps it is the attenuation of this character in the albino which renders this form impossible to feralize, as five unsuccessful attempts by Donaldson (Wistar Institute) have shown.¹—CARL HARTMAN, *The University of Texas, Austin, Texas.*

WOODLAND JUMPING MOUSE NEAR TUXEDO, NEW YORK

On the morning of September 4, 1920, at the boy scout camp in the Interstate Park, some six miles east of Tuxedo, New York, I found in a mouse trap set the evening before an adult male of *Napæozapus insignis*. This particular trap had been placed in some low woods near a small burrow opening beneath a clump of bushes, and the wire loop had struck the mouse only at the base of the tail. The night had been cool; and this had doubtless a marked effect upon the behavior of the jumping mouse, for the trap had been dragged only four feet. Its victim when found was in the sleepy condition of hibernation, showing the result of the lowered temperature even at this early date, for it became active again when warmed.

The only previous records of this species of which I am aware, anywhere in the vicinity of New York City, are those of Mr. Rhoads at Lake Hopatecong, New Jersey,² and of Doctor Mearns in the Catskill Mountains, New York.³ According to Mr. Rhoads this jumping mouse is found in both Pennsylvania and New Jersey in parts of the upper transition zone where no "boreal islands" exist, and certainly the spot where the present example was captured had no particularly boreal aspect.—JAMES P. CHAPIN, *American Museum of Natural History, New York.*

¹ Unpublished data, in addition to the following: Donaldson, Henry H., 1916, "Experiment on the feralization of the albino rat;" Carnegie Yearbook No. 15 of the Carnegie Inst., pp. 200-201.

² S. N. Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1897, p. 29; Mammals of Pennsylvania and New Jersey, 1903, p. 112.

³ Dr. E. A. Mearns, Proc. U. S. Nat. Mus., vol. 21, 1898, p. 348.

WANTED—DATA ON THE RED SQUIRREL

I am getting together material for a monograph on the red squirrel and I should be grateful for any data on this species. Any accurate information, no matter how fragmentary, will be welcome. I should be particularly glad of notes on family life. First-hand accounts, with all details, of destruction of birds or eggs by this species are desirable, and equally desirable are data on cases where red squirrels have *not* molested nests when the opportunity offered. References to literature which the reader believes to be relatively inaccessible will be appreciated, verbatim quotations, with exact citation of publication, preferred. It is perhaps hardly necessary to state that full credit will be given for all information used.—A. BROOKER KLUGH, *Queen's University, Kingston, Canada.*

THE CORRECT NAME OF THE WEST AFRICAN PYGMY SQUIRREL

Du Chaillu was the discoverer of the West African pygmy squirrel and has also been credited with its original description as *Sciurus minutus* (Proc. Boston Soc. Nat. Hist., VII, 1860, p. 366). Later Major (Proc. Zool. Soc. London, 1893, pp. 181, 187, 189 and 215) included it among his Nannosciurinae, but without separating it generically from the East Indian or South American representatives of that subfamily. It remained thus *Nannosciurus minutus* (Du Chaillu) until Thomas (Ann. Mag. Nat. Hist., (8) III, 1909, pp. 469, 474 and 475) created a new genus *Myosciurus* for the West African form, with *Sciurus minutus* Du Chaillu as type by monotypy. Hollister (Proc. Biol. Soc. Washington, XXXIV, 1921, p. 135) changed this name to *Myosciurus minutulus* on the ground that Du Chaillu's name was preoccupied by *Sciurus minutus* Lartet, a fossil species.

Accepting Hollister's revision as correct, I later happened to compare Leconte's descriptions of mammals from the Du Chaillu collection. I came to the conclusion that Leconte's *Sciurus pumilio* fitted the West African pygmy squirrel and could in no way be identical with, as Trouessart supposed, his *S. subviridescens* (= *Æthosciurus poensis*). Hollister, to whom I communicated my findings, asked me then to prepare this note for publication.

Witmer Stone of the Academy of Natural Sciences of Philadelphia kindly informed me that though they have a number of mammals collected by Du Chaillu, there is no specimen positively identifiable as Leconte's *Sciurus pumilio*. Glover M. Allen, who is sure that the type of *Sciurus minutus* Du Chaillu is not in the Cambridge Museum, supposes that Du Chaillu went first to Philadelphia and left his specimens with Leconte, who then was the first to describe *Sciurus pumilio* (Proc. Ac. Nat. Sci. Philadelphia, IX, 1857, p. 11). Three years later, as stated above, Du Chaillu's own description appeared without any mention of Leconte's previous work.

Trouessart seems to be responsible for the confusion. In his first catalogue and in subsequent references he places *pumilio* in the subgenus *Heliosciurus*: *Sciurus (Heliosciurus) pumilio* (Bull. Soc. Et. Sci. Angers, X, 1, 1880, p. 84; Le Naturaliste, I, no. 37, 1880, p. 292; *op. cit.*, no. 40, 1880, p. 315; Bull. U. S. Geol. Geogr. Surv. Terr., IV, no. 2, 1881, p. 306). He finally disposes of *pumilio* in his second catalogue (Cat. Mamm. Viv. Foss., 1897, p. 406) as a synonym of *Xerus (Paraxerus) poensis*, connecting "*pumilio et subviridescens*." From then on *pumilio* disappears from the literature.

Considering the above facts I can see no reason why *pumilio* should not stand and why *Myosciurus pumilio* (Leconte) has not priority over other names. *Myosciurus minutus* (Du Chaillu) and *Myosciurus minutulus* Hollister should be considered synonyms.—HERBERT LANG, *American Museum of Natural History, New York.*

MAGPIE AS SENTINEL FOR RABBITS

The following note sent me by Capt. Henry Savile of Cheltenham, England, shows that the magpie serves the British rabbits much as our bluejay does several American fourfoots.

"I saw rather an interesting little thing the other day, showing that wild animals do communicate with each other. In the center of a large field was a rabbit warren. One evening, while dressing for dinner, I saw a black stable cat stalking the bunnies. Just before it got within springing distance, and as it was lashing its tail from side to side, from a small coppice, out flew two magpies, gave a cry and every rabbit disappeared. I saw this six nights running, and my host told me it had been the same every night for some time."—ERNEST THOMPSON SETON, *Greenwich, Conn.*

DEATH OF CHARLES B. CORY

Charles Barney Cory, well known as one of the most prominent of American ornithologists, died in Ashland, Wisconsin, July 31, 1921. Although chiefly devoted to the study of birds, he had given considerable time to mammals and, especially by the production of his book on the "Mammals of Illinois and Wisconsin," had placed all mammalogists in his debt.

He was born in Boston, January 31, 1857, and was descended from old New England stock. His interest in natural history began in his teens and before he was twenty he had formed a considerable collection of birds. For many years he was possessed of an ample fortune which permitted him to follow his naturalist's bent without let or hindrance. A large share of his attention in earlier life was given to Florida and the West Indies. His collections from these regions, although mainly ornithological, included many mammals, quite a number of which are still preserved in the Field Museum. He was the first to call attention to the differentiation of the Florida cougar to which he gave the name *Felis floridana*. This name being preoccupied, it was renamed in his honor, *Felis coryi*.

For the last fifteen years of his life, after having suffered the loss of his fortune, he held the responsible position of curator of zoology in the Field Museum of Natural History of Chicago. Here he labored most assiduously in the study of birds and, after considerable other work, engaged in the preparation of a series of volumes under the title "Birds of the Americas," only two parts of which had appeared at the time of his death. Among his earlier books were many known to naturalists the world over, as "Birds of the Bahamas," "Beautiful and Curious Birds of the World," "Birds of Haiti and San Domingo," "Birds of the West Indies," "Birds of Illinois and Wisconsin," "Hunting and Fishing in Florida," and "Naturalist in the Magdalen Islands."

He was a man of jovial disposition, fond of a good story, fond of music, fond of games of all kinds and interested in many things besides natural history. As a young man he gave much time to outdoor sports and in middle life he became passionately devoted to the game of golf in which he attained exceptional skill. Throughout a varied and active life, his love for animals, especially birds, was maintained to the end.—W. H. OSGOOD, *Chicago, Ill.*

RECENT LITERATURE

Bresslau, Ernst. THE MAMMARY APPARATUS OF THE MAMMALIA IN THE LIGHT OF ONTOGENESIS AND PHYLOGENESIS. WITH A NOTE BY J. P. HILL. London: Methuen & Co. Pp. i-vii, 1-145, with 47 illustrations. 1920.

This splendid book is a résumé of the author's extensive investigations on the development of the milk-glands and related structures in mammals and on the evolutionary history of the mammary apparatus. The subject is divided into three chapters describing the development of the mammary organs in the three principal groups of mammals, Monotremata, Marsupialia, and Placentalia.

The development of the mammary apparatus does not begin with the arrangements for the accomodation of the young, i.e. with the formation of the pouch, but much earlier, with structures which the author terms primary-primordia, that is, gland areas. These are followed in *Echidna* by the development of the incubatorium and at last by mammary glands. The gland areas act as a hindrance to the extension of the developing panniculus carnosus muscle immediately after birth. Thus there remains an oval, muscle-free area on the ventral side of the trunk which later develops into the incubatorium. In *Ornithorhynchus* the incubatorium is absent, most likely an adaptive feature in this aquatic animal. The marsupium or pouch in marsupials is in no way to be compared with the incubatorium of *Echidna*. It arises as the result of developmental processes in the epidermis which lead to the formation of so-called marsupial pockets, which are entirely unrepresented in *Echidna*. The great apparent similarity of incubatorium and marsupium in the adult animals rests solely on convergence. Among the Didelphyidæ there are many pouchless forms in which a marsupium never existed. No pouch rudiments can be found in the Placentalia, since a pouch stage is not included in the phylogensis of this group.

The original nipple is represented by the simple type of eversion nipple which forms the common point of departure for the evolution of the marsupial as well as of the placental nipples. This type arises from the nipple pouches, discovered by Morgan, the final nipple appearing through eversion of the pouch. Another type, the so-called proliferation nipple, is formed through the involution of the nipple pouch stage. Here the nipple wall is formed essentially by the cutis, the apical portion only by the original primordia; whereas in the first mentioned type of nipple almost the entire epithelial covering is furnished by the original primordia. The so-called milk-streaks of placental embryos are homologous to the primary-primordia of monotremes and marsupials. From these milk-streaks spring the nipples and milk-glands of the Placentalia and their development is much like that in marsupials.

The interesting discussions on the number and arrangement of nipples in marsupials, on the specializations of this organ in placentals, on the mammary hairs, and other related questions do not lend themselves for further condensation in this review. It is to be regretted that some of the illustrations are not better reproduced.

—A. H. Schultz.

Michelsson, G. DIE HAUTMUSKULATUR DES IGELS (*ERINACEUS EUROPAEUS*). Morphol. Jahrb., vol. 51, pp. 147-229. 1921.

A careful, detailed description of the cutaneous musculature of the hedgehog, *Erinaceus europæus*, and a comparison of these muscles with related structures in

other mammals. Thirty-five specimens of the hedgehog were dissected and some interesting variations in the cutaneous musculature were found. The author concludes that the facial musculature in particular represents a mixture of primitive conditions, resembling those found in *Echidna*, and those existing in much higher forms. The large orbicularis muscle is restricted to the hedgehog, but seems to have developed from the musculus humero-dorsalis, which has a very wide distribution among mammals. All the facial and cervical musculature is supplied from the nervus facialis, and all the trunk musculature, except the musculus dorso-cuticularis, from the anterior thoracic nerve.

—A. H. Schultz.

-
- ACKERKNECHT, EBERHARDT. Über den Begriff und das Vorkommen der Spalten im Säugetierkörper. *Anat. Anz.*, vol. 54, pp. 465-490. November 30, 1921.
- ANDREWS, C. W. Note on a bear (*Ursus savini*, sp. n.) from the Cromer Forest-bed. *Ann. and Mag. Nat. Hist.*, ser. 9, vol. 9, pp. 204-207. February, 1922.
- ANTHONY, H. E. From humid forest to snow-capped height in Ecuador. *Nat. Hist.*, vol. 21, pp. 459-473; 13 figs. September-October, 1921. (Contains many notes on mammals.)
- Mammals collected by William Beebe at the British Guiana Tropical Research Station. *Zoologica*, vol. 3, no. 13, pp. 265-285; 2 pls. December 24, 1921. (Lists 56 species from the station, and 4 additional forms from Georgetown. An appendix by Beebe lists species seen but not collected and preserved, and brings the total number at the station to 70.)
- BAKER, FRANK COLLINS. The importance of ecology in the interpretation of fossil faunas. *Ecology*, vol. 2, pp. 277-280. October, 1921 (January, 20, 1922).
- BAKER, F. S., C. F. KORSTIAN, AND N. J. FETHEROLF. Snowshoe rabbits and conifers in the Wasatch Mountains of Utah. *Ecology*, vol. 2, pp. 304-310. October, 1921 (January 20, 1922).
- BLAINE, GILBERT. Three new races of *Cephalophus monticola*. *Ann. and Mag. Nat. Hist.*, ser. 9, vol. 9, pp. 174-176. February, 1922. (New subspecies from Rhodesia and Zululand.)
- CHAPMAN, FRANK M. A life of abundant accomplishment. *Nat. Hist.*, vol. 21, pp. 515-519. September-October, 1921. (Sketch of the life and work of Dr. J. A. Allen, 1838-1921.)
- EVERMANN, BARTON WARREN. Fur seals off the Farallones. *Science*, n. s., vol. 54, pp. 547-548. December 2, 1921.
- FERNANDEZ, MIGUEL. Schuppe, Haar und Haarscheibe der Säugetiere. *Anat. Anz.*, vol. 54, pp. 506-526, 1 pl. December 12, 1921.
- FLOWER, S. S. Report on the Zoological Service for the year 1920 in which is included the 22nd annual report of the Giza Zoological Gardens. Ministry of Public Works, Egypt, Zool. Service, Pub. no. 34, pp. 1-20. Cairo, 1921. (On October 6, 1920, the Giza gardens contained 328 mammals of 87 forms.)
- GRINNELL, JOSEPH. Two new rodents (genera *Thomomys* and *Marmota*) from the eastern border of California. *Univ. California Pub. Zool.*, vol. 21, pp. 239-244, 6 figs. November 7, 1921. (Describes *Thomomys perpallidus amargosae*, Shoshone, Inyo County, California; and *Marmota flaviventris fortirostris*, White Mountains, Mono County, California.)

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- GROTE, HERMANN. Neue Erdferkel (*Orycteropus*) aus Deutsch-Ostafrika und Kamerun. Archiv f. Nat., 87 Jahrg., Abt. A, Heft 7, pp. 121-127. 1921. (Describes five new subspecies of *Orycteropus afer*.)
- HAAGNER, A. K. A guide to the National Zoological Gardens of South Africa. Pp. 1-54, many illustr. Pretoria. October, 1921.
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- HIRSCH, MAX. Der Lückzahn von *Sus domesticus*, ein Beitrag zur Entwicklungsgeschichte des Gebisses von *Sus domesticus* und zur Kenntnis des Wesens der Dentitionen. Anat. Anz., vol. 54, pp. 323-330. October, 1921.
- HOLLISTER, N. Report of the superintendent of the National Zoological Park for the fiscal year ending June 30, 1921. Ann. Rep. Smithsonian Inst., 1921, pp. 84-99. December, 1921.
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- KLOSS, C. BODEN. Seven new Malaysian mammals. Journ. Fed. Malay States Mus., vol. 10, pt. 3, pp. 229-234. 1921. (New forms of *Balionycteris*, *Petaurista*, *Sciurus*, *Lariscus*, and *Rattus*.)
- KLUGH, A. BROOKER. A correction concerning the life zones of Canada. Biol. Bull., vol. 41, pp. 272-275. November, 1921 (January, 1922). (Extends Transition Zone northward in Ontario to mouth of Shawanaga River, including Bruce Peninsula therein.)
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- MERRIAM, JOHN C., AND CHESTER STOCK. Occurrence of Pleistocene vertebrates in an asphalt deposit near McKittrick, California. Science, n. s., vol. 54, pp. 566-567. December 9, 1921.
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- How skunks defend themselves. Amer. Forestry., vol. 28, pp. 26-29, 41, 10 figs. January, 1922. (Popular account of North American Mustelidae.)
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- The masked civets (*Paguma*) of western China. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 617-618. December, 1921. (New: *Paguma larvata yunalis* and *P. l. rivalis*.)
- On three new Australian rats. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 618-622. December, 1921. (New: *Leporillus jonesi*, *Rattus villosissimus profusus*, and *Pseudomys australis oralis*.)
- New Hesperomys and Galea from Bolivia. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 622-624. December, 1921.
- Two new species of slow-loris. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 627-628. December, 1921. (Describes two new species of *Nycticebus*.)

- THOMAS, OLDFIELD. On some interesting hedgehogs from the Persian Gulf. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 142-144. January, 1922. (Three new forms of *Paraechinus*.)
- On some new forms of *Ochotona*. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 187-193. February, 1922. (Describes 6 new species and subspecies from central Asia.)
- Some notes on ferret-badgers. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 193-196. February, 1922. (New forms of *Melogale* and *Helictis*.)
- On the systematic arrangement of the marmosets. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 196-199. February, 1922. (One new species: *Mico leucippe* from lower Amazon.)
- THOMAS, OLDFIELD, AND MARTIN A. C. HINTON. The Mammals of the 1921 Mount Everest Expedition. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 178-186. February, 1922. (Pikas were seen at an altitude of 20,100 feet. New species of *Cricetulus*, *Phatomys*, and *Ochotona*.)
- TROUSSERT, E.-L. La Distribution Géographique des Animaux. Pp. 1-332; i-xii; 14 figs., maps. Gaston Doin, Paris, 12fr. 1922. (A volume of the Encyclopédie Scientifique, Bibliothèque de Zoologie.)
- WALKER, ALEX. Some notes on the preparation of mammal skins. Oologist, vol. 38, pp. 166-170. December, 1921.
- ZUKOWSKY, LUDWIG. Mitteilungen über eine anscheinend neue Form von *Hylochoerus* aus dem Winterhochlande, vom Mutjekgebirge und vom Meru-Berge. Archiv f. Nat., 87 Jahrg., Abt. A, Heft 1, pp. 179-191; 1 fig. July, 1921. (*Hylochoerus schulzi*, sp. nov.)
- Wissenschaftliche Bemerkungen über das Wild des Kaokofeldes unter Berücksichtigung der Aufzeichnungen und der Sammlung des Herrn Hauptmann a. D. Steinhardt. Reprint from Steinhardt's "Vom wehrhaften Riesen und seinem Reiche," ed. 2; separates paged 1-15. October 1, 1921. (New species: *Opsiceros occidentalis*.)

CORRESPONDENCE

THE ZOOLOGICAL RECORD

The Editor, Journal of Mammalogy:

I should be glad if you would draw the attention of your readers to the present position of the Zoological Record.

Owing to the collapse of the International Catalogue of Scientific Literature, in connection with which the Record was published from 1906 to 1914, the Zoological Society of London has undertaken to bear the whole financial responsibility for the preparation and printing of the Record.

Owing to the great increase of the cost of printing and to the very meagre support accorded to the Record by zoologists and zoological institutes generally, the financial burden of this undertaking on the Zoological Society is becoming very severe. The cost of printing the Record now amounts to between £1500 and £2000 annually and the Society receives back by subscribers and sales less than 25 per cent of this sum; I fear, therefore, unless zoologists are prepared to make greater efforts to support the undertaking, there is a strong possibility that the Council of the Zoological Society may refuse to find this large sum each year.

It appears, therefore, to be the duty of every zoologist to help so far as he is able to support this most invaluable work. All particulars and forms of subscription can be obtained from the Secretary of the Zoological Society, Regents Park, London N. W. 8., but I may mention that the price of the whole volume is now £2. 10. 0. and the price of the separate parts a proportional smaller sum.

Yours faithfully,
W. L. Sclater.

London, 1 February, 1922.

FOURTH ANNUAL MEETING IN NEW YORK

The Fourth Annual Meeting of the American Society of Mammalogists will convene in New York City, May 16-18, 1922. Sessions devoted to the reading of papers, discussion, and business, will be held from 10:00 A. M. to 4:30 P. M., May 16-17, in the American Museum of Natural History. There will be an evening session with motion pictures, May 17. Members of the Society will have an opportunity on May 18 to visit the new Heads and Horns Building and other places of interest in the New York Zoological Park as guests of the New York Zoological Society. The whole meeting promises to be exceptionally interesting and important. The Committee on Arrangements consists of Mr. H. E. Anthony, chairman; Mr. Herbert Lang; Dr. Robert Cushman Murphy; and the Corresponding Secretary, ex-officio. Hotel headquarters will be at the Hotel Majestic, 72nd Street and Central Park West, five blocks south of the American Museum.

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No. 3

THE BREATHING OF THE FLORIDA MANATEE (*TRICHECHUS LATIROSTRIS*)

By G. H. PARKER

A man may live some two months without food, a week or more without water, but only a few minutes without air. This dependence upon an almost immediate supply of oxygen is characteristic not only of man but of all other warm-blooded vertebrates. All such animals die sooner from lack of air than from lack of water or of food. But a number of these warm-blooded forms, both among the birds and the mammals, have adapted themselves to temporary life under water where they are for all practical purposes cut off from the oxygen of the air.

Among the birds the divers exhibit this peculiarity conspicuously, but the recent observations of Alford (1920), of Bolam (1921) and of Taylor (1921) show that ducks and grebes stay under water scarcely a minute and usually not over half a minute.

In this respect the water birds are far exceeded by a number of mammals especially by those that live in the sea, as, for instance, the whales, porpoises, and other cetaceans. Beale (1839, p. 44), who was a surgeon on a whaler and was reputed a good observer, declared that sperm whales could remain under water from an hour to an hour and twenty minutes, and Andrews (1916, p. 57) quotes a case reported by Captain Melsom of a blue whale that remained below the surface 50 minutes, then spouted 20 times, and again went down for 40 minutes. Andrews himself (1909) recorded an instance of a humpback whale that remained under water 20 minutes and of a finback that was under 23 minutes. Whether the older records of an hour or more of submergence will be confirmed or not is a question for the future to settle,

but quite aside from this the very fact that cetaceans may live twenty minutes or more without direct access to air is in itself a most remarkable condition and shows how highly specialized these creatures are as compared with their near relatives the terrestrial mammals.

In addition to the cetaceans the seals and especially the sea-cows or sirenians are mammals that lead an aquatic existence. In fact it is probable that the sea-cows, like the cetaceans, never come upon land at all, but remain always in the water. They inhabit the shallow seas of the warmer regions and are common about the mouths of rivers which they ascend for considerable distances. They are inoffensive quiet creatures feeding upon sea-weeds and other aquatic plants. The east coast of Florida is inhabited by a single species, *Trichechus latirostris* (Harlan), which can often be seen in the waters of Biscayne Bay near Miami. It was during my sojourn at the laboratory of the Miami Aquarium Association, at Miami Beach, Florida, that I had the opportunity of studying three of these animals which were contained in a large outside basin on the grounds of the aquarium. I am indebted to the officers of the Miami Aquarium Association for the opportunity I there had of observing the habits of these sea-cows, especially their respiration, under conditions that were as near natural as possible.

The three sea-cows or manatees, as they are commonly called, had been confined in the aquarium nearly a year. In the course of that time they had become extremely tame and lived a life of sluggishness much as they do in nature. They fed freely on cabbage leaves and appeared in all respects to be in excellent condition. After a full meal they would lie quietly in the water often for hours at a time, their apparent repose being interrupted only by an occasional rising to the surface for air. As is well known they rest under water in a curved position with the head and tail depressed and the back arched up and near the surface. When they rise to breathe, the back usually breaks the surface of the water first, after which the head emerges. Expiration and inspiration are then quickly accomplished whereupon the animal slowly sinks again below the surface of the water. Two or three such respiratory acts commonly occur, one quickly following the other, after which the manatee sinks into the water to remain quietly there for a considerable period. These operations are carried out with slowness and regularity so that it is comparatively easy with a watch in hand to take complete records of as many as three animals at one time.

The three manatees at the Miami Aquarium were of very different sizes so that they were easily distinguishable. The largest one was a female of about three meters in length. The next in size was a male about two and a quarter meters long. And the smallest was a young one of undetermined sex somewhat less than two meters from snout to tail. In the late afternoons these three animals were commonly found lying nearly parallel one to the other and exhibiting no other motion than the occasional respiratory one already described. Under such circumstances continuous records could be kept of the breathing of the animals for periods well over an hour. Each set of records included the lengths of time covered by the breathing periods, the number of breaths in each period, i.e., the number of times the nostrils were brought to the surface and opened and closed, and finally the resting periods or lengths of time each manatee remained quietly resting under water. The details of three such sets of records, each covering about an hour, are given in table 1.

It is evident on inspecting table 1 that in all three sets of records the young manatee came most frequently to the surface to breathe, the male less frequently and the female least frequently. The details of this table are, however, best appreciated by a comparison with table 2 which gives in compact form the general averages from table 1.

On comparing these two tables it will be seen that the breathing period in the young manatee varied from 20 seconds to 3 minutes and averaged 49 seconds. In the male it ranged from 20 seconds to 3 minutes and averaged 1 minute. In the female it ran from 20 seconds to 3 minutes and averaged 1 minute and 17+ seconds. Although the range in the length of the breathing period is much the same for the three individuals, table 1 shows that short periods are more characteristic of the young, longer ones of the male, and still longer ones of the female.

The numbers of breaths taken in the breathing periods by the three manatees vary in each instance between 1 and 4 except that there is one record of 5 in the breathing of the male. Nevertheless table 1 shows that the young takes a smaller number of breaths, average 1.7—, than the male, average 2.2, and the male a smaller number than the female, average 2.6.

Although it is true that the young manatee came to the surface more frequently than the male and the male more frequently than the female, and, further, that the young one took fewer breaths per period than the male, and the male than the female, it is also true that

TABLE 1

Breathing records of three Florida manatees (*Trichechus latirostris*) taken from the animals in the Miami Aquarium, set A on June 10, set B on June 18, and set C on June 14. Each set covers a period of about an hour and includes records from a young animal less than two meters long, from a male about two and a quarter meters long, and from a female about three meters long. The breathing periods are given in minutes and seconds. The number of breaths indicates the number of times the head was brought to the surface and the nostrils were opened and closed in each breathing period. The resting periods show the lengths of time in minutes and seconds spent quietly under water

SETS	ANIMALS	PERIODS, ETC.	TIMES IN MINUTES AND SECONDS, ETC.												MEANS
A	Young	Breathing periods	:50	1:15	1:30	:20	:30	1:00	:20	1:00	:30	:40	1:20		:50+
		Number of breaths	2	4	4	1	1	2	1	2	1	2	3		2:1-
		Resting periods	4:10	3:30	7:20	2:20	3:00	3:20	4:40	5:40	3:50	4:40	6:20		4:26+
	Male	Breathing periods	1:25	:25	1:10	:40	:30	1:00	:40						:50
		Number of breaths	3	1	3	2	2	3	2						2.3-
		Resting periods	9:00	4:40	8:25	6:40	5:10	7:40	7:40						7:02+
B	Female	Breathing periods	1:20	:40	1:00	:50	:50								:56
		Number of breaths	3	2	3	2	2								2.4
		Resting periods	12:50	8:40	7:20	15:10	12:10								11:14
	Young	Breathing periods	:20	:30	1:30	:20	1:20	:25	:20	:30	1:00	:20	:25	:30	:36+
		Number of breaths	1	1	2	1	2	1	1	1	2	1	1	1	1.2+
		Resting periods	9:30	3:30	2:00	7:30	4:00	4:00	2:30	3:00	5:30	8:00	2:10	4:20	4:37-
	Male	Breathing periods	:30	3:30	2:00	:30	1:10	1:00	:50						1:21+
		Number of breaths	1	5	4	1	3	2	2						2.6-
		Resting periods	13:00	9:00	11:30	5:30	8:15	7:20	9:40						9:11-
	Female	Breathing periods	1:00	3:00	1:30	:20	1:00								1:22
		Number of breaths	3	4	3	1	3								2.8
		Resting periods	14:00	11:20	12:30	13:00	14:00								12:58

the lengths of breath, i.e., the time that the nostrils are open, is about the same for the young, 30— seconds, that it is for the male, 27+ seconds, and for the female, 30— seconds. In other words, the actual breathing operation occupies an interval of time which was about the same for all three manatees. This unit is used in small multiples by the young, 1.7— in larger multiples by the male, 2.2, and in still larger ones by the female, 2.6.

The interval between two breathing periods is the resting period during which the manatee is reposing quietly under water. During this interval the animal is cut off from its supply of air and hence the length of this period is a measure of its adaptation to submergence. The resting period in the young varied from 2 minutes to 9 minutes and 30 seconds with an average of 4 minutes and 37— seconds; in the male it ranged from 4 minutes and 40 seconds to 13 minutes with an

TABLE 2

Average breathing periods in minutes and seconds, average numbers of breaths in each breathing period, average resting period in minutes and seconds, and average length of breath in seconds for the three manatees recorded in table 1. The results are computed from the figures in that table

	YOUNG	MALE.	FEMALE.
Breathing periods.....	:49	1:00	1:17+
Number of breaths.....	1.7—	2.2	2.6
Resting periods.....	4:37—	8:38—	12:01—
Lengths of breath.....	:30—	:27+	:30—

average of 8 minutes and 38— seconds, and in the female it varied from 7 minutes and 20 seconds to 15 minutes and 10 seconds with an average of 12 minutes and 1— second. In general it may be said that taking the period of submergence in the young as unity that in the male was nearly two and that in the female nearly three.

As the young manatee was the smallest of the three, the male next in size, and the female the largest, there appears to be a fairly intimate relation between the size of the animal and its respiratory activities, for the larger the manatee the longer its breathing period, the greater its number of breaths in each such period and the longer it remained under water.

A number of other sets of records were taken from the manatees in addition to those given in table 1, but these sets were incomplete as compared with the three already tabulated in that, instead of extending

over an hour, they were shorter having been interrupted by the unexpected resumption of swimming on the part of one or more of the manatees. Under such circumstances breathing became very much more rapid and the animals moved over the surface of the water in such a way that it was impossible to record accurately their respiratory activities. These incomplete records in so far as they appertain to resting animals show, however, nothing that is not to be seen in the complete records except a maximum period of submergence. In one instance among these incomplete sets the female is recorded as having remained under water 16 minutes and 20 seconds. This is the longest period for a manatee to be under water of which I have a record and exceeds the maxima in table 1 by over a minute. Aside from this the incomplete sets contain nothing of special interest.

It has been stated by some observers that the sea-cows are nocturnal in their habits, but the three animals that came under my observation showed no evidence of this. I often visited at night the pool in which they were kept and I never noticed at that time any greater activity in it than I did during the day time. In the darkness of night it was much more difficult to observe the manatees than in the day, but the large female could be commonly identified in the dim light of night and I have a number of sets of records of her breathing rate at that time. In obtaining these records I usually placed myself on the edge of the pool as close as possible to her head and listened for her breathing as she came to the surface reading the time from a watch kept near at hand and lighted by a flash-light so held as not to illuminate the pool. In this way I found that she was acting much as she did in the daytime and that her submergence or resting periods averaged about 12 minutes. In listening for her breathing I held my face as near the surface of the water as the edge of the pool would permit and on her first emergence she often blew her breath directly in my face. It was far from aromatic, as described by Drexler and Freund (1906, p. 80) for the dugong, but had a most repulsive smell resembling somewhat that of phosphorus. This may have been due to the fact that she with the other two in the pool were fed regularly on cabbage.

The periods of submergence for manatees recorded in this paper agree fairly well with those already contained in the literature. These older records were not very systematically gathered and most of them are of the nature of incidental notes rather than extended statements. The resting or submergence period for American manatees are given by the authors quoted as follows: Chapman (1875, p. 461) about 1 to

1 $\frac{1}{4}$ minutes, Brown (1878, p. 296) on the average 2 $\frac{1}{2}$ minutes, Crane (1881, p. 457) 2 to 3 minutes with a maximum of 6 minutes, Noack (1887, p. 296) every 2 to 3 minutes, and Townsend (1904, p. 86) 5 to 8 minutes, a statement repeated by Gudernatsch (1908, p. 232). The African manatee is said by Noack (1887, p. 300) to come to the surface for breathing every 1 $\frac{1}{2}$ to 2 minutes. The eastern sea-cow or dugong has been reported upon in the same incidental way and with much the same range. Thus Rüppell (1834, p. 113) stated that this sea-cow comes to the surface every minute or so for breathing; Klunzinger (1878, p. 68) gives the rate as once in 10 minutes; and Semon (1896, p. 317) as every 3 to 5 minutes. Dexler and Freund (1906, p. 80) observed the breathing rate in a newly captured dugong to vary from 17 to 65 seconds between breaths and in the imprisoned condition to vary from 43 to 145 seconds. Obviously these more rapid rates both for the manatee and for the dugong are to be ascribed to changes in the animal's activity and not to irregularities of observation, for, when a manatee begins to swim, it at once increases its rate of breathing which may rise to several times a minute. It is only with really quiet animals that such a period as 16 minutes or more is to be observed and then only when the animal is very large (3 meters long, for instance), conditions of observation which have rarely occurred in earlier work.

Florida and West Indian fishermen maintain that when the native manatee is hunted, it will dive and remain under water fully half an hour. Whether this is so or not remains to be seen, but it is not impossible that submergence periods exceeding considerably those given in this paper may be eventually reported.

The observations recorded in this paper show that manatees may remain under water much longer than diving birds or terrestrial mammals and that their normal periods of submergence are so considerable that they must be regarded as specially adapted to an aquatic life though they are obviously much less specialized in this respect than are the whales, porpoises, and other cetaceans. The fact that they bleed profusely when butchered and are what the fishermen call "full-blooded" is one feature in this adaptation, for their blood is probably their chief storage place for oxygen.

SUMMARY

The Florida manatee, *Trichechus latirostris* (Harlan), is highly specialized for an aquatic life. Its breathing is related to its size in that the larger the animal the longer it can stay under water, the

longer it breathes at the surface, and the more breaths it takes while breathing. A small manatee, less than 2 meters long, had an average breathing period of 49 seconds during which it averaged 1.7— breaths. A large manatee, three meters long, had an average breathing period of 1 minute and 17+ seconds during which it averaged 2.6 breaths.

The small manatee had an average submergence period of 4 minutes and 37— seconds with a maximum of 9 minutes and 30 seconds. The large one had an average submergence period of 12 minutes and 1— seconds with a maximum of 16 minutes and 20 seconds. These submergence periods far exceed those of diving birds and terrestrial mammals, but are not so long as those of cetaceans.

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RODENTS AND RECLAMATION IN THE IMPERIAL VALLEY¹

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Human occupancy of a region always results in great changes in the animal life therein. Species of mammals, for instance, that afford man meat, hides, or fur are almost sure to decrease in number, whereas other species, including some that are harmful to man's interests, frequently increase. In the case now under discussion, both classes of animals are represented.

The recent reclamation of the major part of the Imperial Valley, which occupies the southern portion of the Colorado Desert in the southeastern corner of California, is of unusual interest in many ways, but particularly so in connection with its widespread influence on the distribution and abundance of the rodents of that region. The area involved consists of the entire delta of the Colorado River. This delta is one hundred miles in length and has an average width of thirty miles; it extends from Salton Sea on the north to the Gulf of California on the south, and from the Cocopah Mountains on the west to Arizona and Sonora on the east. About one half of the delta lies within the United States, whereas the other half lies south of the Mexican boundary in Lower California and Sonora.

That part of the delta region lying within the Imperial Valley in the United States is practically all below sea level. From surveys made in 1915 the elevation of the Imperial Valley was found to vary from sea level at Calexico to 234 feet below sea level at Salton Sea. In Lower California nearly all of the delta is above sea level. The crest or divide of the delta lies several miles south of the International Boundary.

The Colorado Desert, including the delta region, is characterized by marked aridity and extremely high summer temperature. Extensive areas on both the east and west margin of the Imperial Valley are occupied by hundreds of sand dunes. The rich alluvial soil of the delta is over one hundred feet in depth for hundreds of square miles. Previous to the construction of the irrigation system the Alamo and New Rivers, both being overflow channels of the Colorado River, were the only waterways of any size and importance traversing the northern half of the delta. Both of these were intermittent rather than permanent streams.

¹ Contribution from the University of California Museum of Vertebrate Zoology.

Under the original desert conditions only true desert vegetation flourished in Imperial Valley and much of the best land of the delta was covered with creosote-bush, arrow-weed and quail-brush (*Atriplex*). Mesquite was most common in sandy areas where it helped in the formation of sand dunes. Cottonwood, willow, cat-tails, cane and other riparian trees and plants were restricted to sloughs along the overflow channels. Under true desert conditions in the Colorado Delta certain rodents were closely associated with certain plants or certain types of ground. For example, the pallid muskrat (*Ondatra zibethica pallida*) and Sonora beaver (*Castor canadensis frondator*) were confined to the river, ponds, and other permanent waterways. The western desert cottonrat (*Sigmodon hispidus eremicus*) and desert harvest mouse (*Reithrodontomys megalotis megalotis*) were typical inhabitants of the sedge or tule along the banks of streams. The Colorado Valley woodrat (*Neotoma albigula venusta*) was a characteristic dweller of mesquite thickets. The Yuma round-tailed ground squirrel (*Citellus tereticaudus*) and allied kangaroo rat (*Dipodomys merriami simiolus*) were two typical inhabitants of the dry sand dunes, while the Imperial Valley gopher (*Thomomys perpallidus albatus*) was found sparingly in sandy places where sufficient food could be had. The gopher, being unable to forage about for any great distance above ground, had the most restricted distribution of any of the mammals.

Having ascertained conditions as they existed prior to the reclamation of Imperial Valley, the changes that have taken place there during the past fifteen years may now be noted. One of the first and most important changes was the construction of a network of irrigation canals. These vary in width from four to one hundred and sixty feet; their aggregate length runs into hundreds of miles, there being over three hundred miles of main canals to say nothing of the laterals. The removal of the native vegetation and the breaking up and cultivation of hundreds of thousands of acres soon followed. The levelling of the land so that all parts of a field might be flooded during the frequent summer irrigation came next. Alfalfa and cotton fields now mark the former site of extensive stretches of creosote and other desert vegetation. Man's occupancy of the region also resulted in the destruction of many of nature's best rodent destroyers. This reduction, by man, in the numbers of snakes, coyotes, wild cats, kit foxes, coons, badgers, hawks, and owls has especially assisted certain rodents, such as gophers, in their rapid increase, since it removed one of their most important natural checks.

The three most important conditions necessary for the successful life of any species of animal, as pointed out by Grinnell in his Colorado River Report, 1914, are adequate food supply, safe breeding dens and places for temporary refuge in extremity. A sufficient supply of the proper sort of food is the first requirement. Unless safe breeding dens are available the future generations of a species are placed in jeopardy. To a kangaroo rat that is being closely pursued by a hungry kit fox the nearness of a protecting burrow may be a question of life or death. With these essentials of rodent existence in mind, let us note the effect of the recent radical changes in Imperial Valley on the various species involved.

Field work carried on by the writer in March and April, 1921, in the Imperial region on both sides of the International Boundary, showed that the rodent population of that region could be readily divided into two classes. The first class consists of rodents that tend to be driven out by reclamation. Belonging to this category are the round-tailed ground squirrel, Colorado Valley woodrat, kangaroo rat and pocket mouse.

The other class is composed of species that have benefited by, and increased as a result of, the reclamation of desert lands. The harvest mouse, cotton rat, beaver, muskrat and gopher belong to this second class. The species that are driven out by reclamation are those that are most abundant in the sand dune areas. The true desert rodents are able to live without water other than that obtained from the food that they eat; as a matter of fact, irrigation drives them out. With the one exception of the gopher, the rodents that have increased under reclamation are all water or stream-side dwellers.

Reclamation in Lower California has not been carried on as rapidly or as extensively as it has on the American side, and as a result large areas still remain where wholly natural conditions prevail. An excellent chance was thus afforded for observing original conditions and for seeing reclamation forces in actual operation. The immediate results of different stages of reclamation and irrigation were also observed. In one instance, an area one mile long and one-half mile wide lying just south of the border and eleven miles east of Mexicali was studied in detail. One half of this selected area was covered by original mesquite crowned sand dunes surrounded by patches of arrow-weed and quail brush. The rest of the tract had recently been or was being cleared, leveled, and planted to cotton or alfalfa. The ground squirrels, pocket mice, kangaroo rats and woodrats that had formerly inhabited the

land were thus forced to seek protection in the sheltering mesquite thickets of the adjoining sand dunes. Periodic flooding of the fields during irrigation destroyed the burrows of such rodents as returned to their former homes in the cultivated fields. This concentration of the rodent population meant increased competition for food. At the same time the food producing area was greatly reduced especially where cotton was raised. As a result, considerable damage was done, particularly by the little squirrels (*Citellus*), to grain fields that were enclosed or bordered by mesquite thickets. Some difficulty also resulted from the burrowing of the rodents, chiefly squirrels, into sandy irrigation ditch banks between irrigations. Some ditches or levees that remained unused for a few months were thus rendered useless. The abundance of squirrels at this locality was indicated by four being caught in as many days in one trap set at the mouth of one burrow. Poisoning with barley coated with strychnine afforded temporary relief, and the gradual settlement of the land resulting in the complete removal of the sand dunes, which are being leveled into fields, means that this first class of rodents will soon be controlled and in many instances exterminated over large irrigated areas. In other words, once their food supply, breeding dens and temporary refuges, the essentials of a successful existence, are all destroyed, the rodents will cease to exist.

In considering the rodents that have increased through reclamation, we find that the construction and use of irrigation canals has been the fundamental cause of their successful battle for existence. The irrigation ditches have simply served as highways for the spread of aquatic or stream-side animals. Thus, harvest mice and cotton rats have followed down along the canal banks through Lower California from the Colorado and Alamo Rivers until they are now to be found in considerable numbers in American territory. On March 17, 1921, the writer found many well-defined runways and trapped an adult breeding male cotton rat one half mile south of the International Boundary near Allison Heading. Six harvest mice were also captured in the cotton rat runways. Extensively used cotton rat runways were also found in Imperial County on the American side of the line, so that this unwelcome rodent is now definitely known to be established in the cotton districts of Imperial Valley. It is unlikely that the harvest mouse will do any considerable damage, but the cotton rat is dangerous. In Texas and certain other gulf states cotton rats have on occasion proved very destructive to cotton and corn crops. These

rats invade cotton fields and carry off the cotton in order to secure the seed of which they are very fond. M. C. Rissinger, who for nine years has been stationed at the Eastside Heading on the main Imperial canal, reports finding a cache of cotton three feet in diameter that had been accumulated by a pair of cotton rats. The Colorado River species, therefore, has the same destructive habits as the related species of the gulf states.

The Sonora beaver, one of the largest living rodents in North America, is common in the Colorado delta. This aquatic species was formerly common all along the Lower Colorado River, but has been greatly reduced in numbers by persistent trapping. It is still abundant in the lower delta region about Volcano Lake. Beavers have invaded the Imperial Valley along two different routes: by the Alamo River and main Imperial Canal on the east side of the delta, and by way of the Black Butte Canal on the west side. At the present time there are in the neighborhood of 100 beavers in the Imperial Valley north of the International Boundary. Nearly half of these are to be found in the Alamo River, whereas the others are scattered about in the larger canals. No beaver sign was noted along New River on the American side. A thriving colony has been established for some time on the Alamo within half a mile of the center of the town of Holtville. Four recently cut willow saplings were noted at this point on March 25, 1921, and many willows, cut by beavers, have lodged against the trestle work of the Holton Interurban bridge west of Holtville. Serious breaks have already been caused by beavers burrowing into canal banks, and it is probable that other breaks will occur especially at points where the canals are built above the general land surface. Complaints of damage to canals by beavers have already been registered from the Imperial Valley, and it is likely that this damage will increase. Beavers are protected by law at all seasons in California. The state law protecting them provides that, where they are endangering the levees, permits to trap or remove them may be issued upon the proper application to the State Fish and Game Commission. However, if it were possible to remove all of the beavers from the American side of the boundary, it would only be a question of a short time until the canals would be reinfested from the breeding stock in Lower California since they have free access along all of the main canals, and beavers and muskrats do not need passports in crossing the International Boundary. While the fur of the Sonora beaver is short, pale and of poor quality, pelts of this animal sell for an average

of about eight dollars each in ordinary years, and in 1920 large raw skins sold for as much as twenty dollars. There appears to be no good reason why the beavers should not be removed wherever they are endangering the canal banks. The value of the pelt should defray the cost of the trapping if this is done at the proper season when the fur is prime and hence of greatest value.

In April, 1894, Dr. E. A. Mearns saw what he believed to be muskrat sign near Seven Wells on the Alamo (Salton) River. It is probable that a few muskrats existed along this stream prior to the construction of the Imperial irrigation system. Muskrats are now to be found in all of the main irrigation canals carrying over ten second feet of water between Salton Sea and the Gulf.

A conservative estimate based upon careful investigation places the present muskrat average population per mile as follows: Large main canals, 40; small mains, 20; Alamo River, 20; New River, 40 (and in places up to 200 per mile). In 1920, 67 muskrats were actually trapped during a single night in a distance of one mile along New River, and at least twice as many were left untrapped. Over 400 muskrats were taken by one trapper in twenty nights on the Brawley main. This trapper set his traps only one night in each place, and trapped about one mile of canal a night. In three months, W. W. Morrison and assistant, caught 1738 muskrats. From the known number of trappers and their catch it is conservatively estimated that 25,000 muskrat pelts were shipped out of the Imperial Valley during the trapping season of 1919-20. It is further believed that the catch (25,000) equaled one half the total population of muskrats.

Muskrats breed every month in the year in the Imperial Valley. Small woolly juvenals barely able to leave the nest and forage for themselves have been caught in mid-winter, and small young have been trapped during every month of the year. The bulk of the young are born between February 15 and October 30. Three and possibly more litters are raised in one year. The litters are relatively small. The average number of embryos in twenty-three pregnant females was six, with three and nine as extremes.

In the Imperial Valley muskrats live and forage entirely within the canals and other waterways. The writer has been unable to find a single instance where muskrats have gone out from the canals and injured growing crops in the adjoining fields. The favorite food of this rodent consists of the natural vegetation, such as cat-tail and grass roots, which grow along the inner banks and tend to clog up the

canals. The pallid muskrat is a typical burrow-dweller. This animal is reported to build houses in certain cat-tail swamps near Salton Sea, but none of the trappers interviewed, or the writer, has ever been able to locate such a muskrat house. It is believed that the mildness of the winter climate makes houses unnecessary to the animal. Some damage is certainly done by muskrats burrowing into canal banks, but this is comparatively slight considering the total numbers that live in the canals. The writer dug out a number of burrows in canal banks and found that much of the damage attributed to the muskrat was really being done by the gopher. None of the muskrat burrows dug out, was found to extend over half-way through the embankment. Normally these rodents begin from one-half to three feet below the water line and burrow straight into the bank. Where the bank is high close to the water's edge, the burrows were found to extend in for two or three feet and then turn abruptly upwards, ending in a nest cavity which is usually placed just above the highest high-water mark. If the bank is low, the rats sometimes burrow over the crest of the bank to reach a protecting clump of brush under which the nest is built. Where two canals are close together, muskrats sometimes burrow from one to the other. They sometimes cause breaks by burrowing around wooden head gates, through which they have been known to gnaw small holes. On the whole, damage to headgates and canal banks, due solely to muskrats, was not found to be as extensive as reported.

Prime muskrat pelts, even if from the warm Imperial Valley, have a decided value. During the trapping season of 1918-19, W. W. Morrison of Holtville caught 1124 muskrats which sold for \$1,108.00, an average of nearly one dollar a pelt. The highest price received for one pelt during that season was two dollars. In 1919-20 Morrison caught 1738 muskrats which sold for \$2,805.00, an average of \$1.61 per pelt. Out of this lot of 1738 skins, five extra large pelts sold for five dollars each and 82, number 1 large, sold for four dollars each. At Eastside Heading, below the boundary, M. C. Rissinger secured 333 muskrats in 1919-20. These skins were mostly small, yet they sold for \$456.25, an average of \$1.34 per skin. Allowing a value of \$1.25 a pelt, which is a very low estimate, we find that the 25,000 muskrats caught in the Imperial Valley in 1919-20 yielded the trappers an income of over \$31,000.00. This record places the muskrat first as to number taken, and second in aggregate value, among the fur bearers of California for that year.

On account of numerous breaks in the canals caused by the burrows of various rodents, including the muskrat, the ditch tenders and some of the irrigation companies consider muskrats as pests, and often men are hired or paid a bounty to trap the animals. The bounty is paid not on the muskrat's head but on his tail so as not to detract from the value of the pelt. There is no gainsaying the fact that muskrats do cause a certain amount of damage. However, the evidence indicates that the damage has often been exaggerated, and investigation has shown that many of the breaks in the canals were not due to muskrats at all. In one instance an extensive break said to have cost upwards of five thousand dollars was widely reported to have been caused by muskrats, but Mr. Rouse, chief engineer of the Imperial Irrigation District, assures me that this particular break was really due to cracks in the soil of the canal bank and not to muskrats at all. However, two out of fourteen of the mutual water companies in the valley do pay a bounty of twenty-five cents on muskrat tails.

Practically all of the professional trappers wait until December, when fur is prime, before they start trapping muskrats. As one trapper said: "It doesn't pay to trap a muskrat in August for twenty-five cents when one can get \$1.50 for the same animal in January." District number four, which is the smaller of the two districts paying bounty on muskrats, covers over 20,000 acres and has 133 miles of canals and waterways. In twelve months during 1919-20 this district, according to their secretary, paid a twenty-five cent bounty on 2395 muskrats. It is obvious that owing to the high prices of fur, nearly all of these muskrats would have been trapped, bounty or no bounty. One outstanding feature of muskrat control is seen in the fact that the market price is much more potent in the reduction of muskrats than the bounty system, and this is true even during years when fur is low in price. After careful investigation and consideration of all the factors concerned, it is believed by the writer that the value of the muskrats' pelts at least equals, and probably exceeds the damage done by these rodents in Imperial Valley.

The Imperial Valley pocket gopher constitutes the real rodent problem in the delta region. Fifteen years ago gophers occurred in very small numbers over small but widely scattered areas of the valley. This species was then so rare that museums had difficulty in securing even a few specimens. Today hundreds could be secured in almost any part of the irrigated sections. What has been the cause of this remarkable increase? The writer believes that the answer to this

question is irrigation and Bermuda grass. Under the original desert conditions food and ground suitable to burrow in were the chief factors that limited the distribution of the gopher.

Bermuda grass was abundant along the Colorado River near the intake of the main Imperial canal in 1910. This grass was carried all over the irrigated land by seed which was carried down stream by the irrigation waters. The banks of irrigation ditches afford safe breeding dens and temporary refuge to gophers. The root-stalks of the Bermuda grass, which flourishes along the margins of the canals, furnish these animals a constant, abundant, and acceptable food supply. The removal by man of many of the natural enemies of the gopher greatly improved the living conditions of these rodents, so that a larger percentage of the young reached maturity, and bred, thus hastening the rapid increase. While man has caused the death of many gophers through drowning, when the fields are flooded during irrigation, a large breeding stock always remains along the canal banks which are never flooded.

Gophers prefer to work in sandy soil. Hard or "tight" ground is avoided. This is well illustrated in districts seven and eight, both of which have a great deal of sandy ground and a corresponding abundance of gophers.

In district seven, 100 gophers have been trapped along one mile of canal in several places. In district eight, which is across the valley from district seven, there is a record of 400 gophers having been trapped in a short time along two miles of badly infested canal. Gophers are now also abundant along the main canals in Lower California. At Eastside and Sharp's headings they were found in March, 1921, to be present, as determined by actual trapping by the writer, at the rate of 105 per mile.

Gophers do not hesitate to invade fields adjoining the canals and here they destroy much alfalfa and other crops. If it were not for the fact that gophers are drowned out by flooding during irrigation they would soon become unendurable pests. There is no chance to starve out the gophers since they can always fall back on the Bermuda grass roots. The gophers often carry Bermuda grass root-stalks about in their cheek pouches and thus aid in the spread of this grass. About one-third of the gophers trapped by the writer at Eastside Heading in March, 1921, had Bermuda grass in their cheek pouches. All of the gophers thus caught were very fat, being fatter than the muskrats taken at the same time.

The breeding season of this gopher is long, extending over several months. According to professional gopher trappers two litters of young are frequently raised in one season. The average number per litter appears to be slightly less than six. As with the muskrats, the average litter is small in number, but this is more than compensated for by more than one litter being raised each season.

Unlike the muskrats, *gophers habitually burrow completely through the canal banks*. They usually keep just above the water line, but when the water in the canal is low the gophers also burrow low, and when the canal is again filled, the water leaks out through the gopher hole; this leakage, unless discovered and stopped in time, results in a break in the canal and in flooding of the surrounding fields. Gophers often burrow through the outside of the ditch banks and thus make connections with muskrat burrows, causing breaks in the canal for which the muskrat receives the blame. At the east end of the Encina flume which crosses New River below the line, gophers have riddled the inside of the main canal which at this point is merely a dirt embankment built up until the crest is nearly twenty feet above the surrounding territory. Gopher burrows in such places are exceedingly dangerous. One gopher at this point could easily endanger the growing crops on hundreds of acres in Imperial County. A narrow cement core built into the center of the canal banks could be cheaply installed at such points and would greatly reduce the danger.

Trapping and local or county bounties are the two control measures that have been most used against the gopher in this region. An officer of district eight reports that during four months in 1920-21 this district paid a bounty of twenty cents a scalp on nearly 15,000 gophers. Districts one and seven each employ two or more regular gopher catchers who are paid on a salary basis. These men trap faithfully and work where the gophers are doing the most damage, but the territory that each trapper can effectively cover is limited. The bounty system soon depletes the funds available and affords no permanent relief. Poisoning has been tried, but has met with poor success for the most part, due apparently to the abundance of food such as Bermuda grass which has been more acceptable to the gophers than the poisoned bait offered. Another difficulty is encountered in the fact that the water in the canals is used throughout the valley for domestic purposes and care must be taken that the water be not polluted by poison or by dead gophers. However, poison experiments which have already been carried on in the Imperial Valley, using a probe to locate the burrow and a bait

that is acceptable to the gopher, indicate that these rodents can be successfully poisoned. While pelts of beavers and muskrats are of considerable value, gopher pelts are worth nothing, and in the Imperial Valley these animals appear to be of no use whatever.

The rodent problems in the Imperial Valley are distinct from those that present themselves elsewhere in the state. Gopher control will be a hard fight in this section, growing harder and more expensive the longer it is put off. Any successful method of control must accord with the habits and food preference of this species, which at the present time are not well understood. A thorough study of the life history of this species should be made. The facts thus obtained, combined with actual field experiments in poisoning these rodents, would save thousands of dollars that are now being wasted in well meaning but ill-advised, unorganized, and wasteful attempts at control.

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A BROWN MUTATION IN THE OPOSSUM (*DIDELPHIS VIRGINIANA*) WITH REMARKS UPON THE GRAY AND THE BLACK PHASES IN THIS SPECIES¹

BY CARL HARTMAN

Through the courtesy of the United States Biological Survey and the United States National Museum I have been enabled to examine three brown specimens of opossums which clearly belong to the species *Didelphis virginiana*. The color of these is strikingly like the cinnamon colored mutant of the roof rat (*Rattus alexandrinus*) described by Patterson (1920) who thinks that this form may be analogous to the cinnamon mutation of the guinea pig described by Castle and Wright (1916). Like the cinnamon rat the brown opossums appeared in the wild; and since the opossum belongs to the order Marsupialia this report is not without genetic interest.

Before entering upon a detailed description of the new specimens it is necessary to recall the normal coat color of the opossum. Two phases, gray and black, have been described for the large North American opossums. In *D. marsupialis texensis* both phases are mentioned by

¹ Contribution No. 153, Zoological Laboratory, The University of Texas.

all authors, the black phase predominating (cf. Allen 1901, and Mearns, 1907). I have had about 20 specimens of this subspecies from San Benito, Cameron County; all of these were black.² For *D. virginiana*, however, Allen (1901) fails to mention the black phase, and one would gather from his monograph that none but the gray occurs in this species. Elliot (1901), however, had two blacks among his twelve Virginia opossums from Florida. In August, 1919, I saw a black of this species lying by the roadside near Oxford, Iowa. At Austin, Texas, the black phase of *virginiana* is found frequently. For example among the last 200 females of my records 15 are designated as "black"; but as the records were made for other than taxonomic purposes it is likely that several blacks escaped description in my notes. The percentage of blacks in central Texas is probably near ten per cent. From these facts it would appear that the black phase has received inadequate attention at the hands of mammalogists, although from the standpoint of genetics the blacks are of special significance.

The chief interest attaching to the black phase pertains to the independence of pigmentation of overhair and underfur. For it should be recalled that in grays and in blacks the underfur is alike, that is, it is white except for the black tip. The long, coarse overhair, however, is either white or black for its entire length on any given animal.³ An animal is gray or black according to the color of the overhair. Some blacks have a few or even many white overhairs among the black, chiefly posteriorly; but there seems to be no intergrading series between the gray and the black phases. Dark gray specimens, for which Bangs (1898) attempted to set up a new subspecies (*D. virginiana pigra*), are often met with in this locality. No analysis of our dark grays has as yet been made, but they, too, are in a different class from the blacks.

Corresponding to these two normal phases of the opossum are the brown animals now to be described in which brown pigment has replaced black. Two specimens, skins Nos. 235543 and 235535, of the United States National Museum, Biological Survey Collection, were caught somewhere near Houstonia, Cooper County, Missouri, December, 1920, and were sent in by Dr. Chas. A. McNeill of Sedalia, Missouri, who states that according to information he has been able to gather

² It is possible that blacks only were selected for shipment and that these therefore do not represent random catches.

³ The writer has among his notes a reference to a Virginia opossum having individual overhairs partly white and partly black. Such specimens must be very rare.

from animal dealers brown opossums are occasionally taken by hunters in Cooper County. The third skin examined is No. 19083 of the United States National Museum, received from Warsaw, Illinois, in 1890. The first is of the "all brown" variety, corresponding to the black phase; that is, all of the overhairs are brown except about a dozen white ones near the tail. It is darker than the other two, possibly approaching chocolate. The underfur is brown-tipped and brown pigment is seen in the skin of the snout and the scales on the proximal 40 mm. of the tail. The ears seem to be black. The other two specimens differ from the first in having the overhair white; in other words they correspond to the normal grays. All the specimens are large and have the extremely short tails characteristic of *D. virginiana*.

To summarize, then, four varieties of *D. virginiana* seem clearly differentiated:

1. The gray phase, with underfur black-tipped, overhair all white.
2. The black phase, with underfur also black-tipped, overhair altogether or for the most part black.

3 and 4. Like 1 and 2, with brown pigment replacing the black.

For an account of the occurrence of the brown mutation among mammals the reader is referred to Castle's book "Genetics and Eugenics" (1920) and to the several articles listed below. Recently Miller (1921) in this journal published a description of a brown mole, an insectivore; and with the present record the mutation is extended to the Marsupialia. This raises the question whether or not there is a very general distribution of the same factors involved in the development of coat color within the class Mammalia.

ADDENDUM.—Since sending the preceding article to the editor of the Journal the writer has been fortunate enough to secure from Doctor McNeill three additional specimens of the cinnamon opossum. They reached Austin, Texas, alive and in excellent condition from Sedalia, Missouri, where Doctor McNeill purchased them. Nothing else is known concerning their history. Of these three one enormous male and one two-year old female have white overhair; the third specimen is a yearling female without any white overhair whatever, that is, it is solid cinnamon. The feet and the base of the tail are brown. The ears are dark except for the unpigmented tip often seen in *virginiana* and *marsupialis*; but the pigmentation is light as compared with the black ears of the gray phase and tends toward brown, especially in the last mentioned individual. In this the ears are the lightest, and distinctly and unmistakably brown.

The iris of the eye was also examined in the three mutants as well as in the normal controls (grays). The iris is generally invisible, but in the bright sunlight it appears as a narrow marginal band. In the gray phase the iris is deeply pigmented, almost black; in the cinnamon mutants the iris is light, blending from the very light inner margin to a distinct brown at the periphery where it disappears under the eyelid.

All pigmented areas of the McNeill mutants, therefore (hair, scales of tail, ears and iris), have the brown color.

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NOTES ON EUROPEAN FOSSIL HORSES

BY ERNST SCHWARZ

The problem of European fossil horses has always attracted the attention of zoölogists. Since the times of Cuvier, the subject has been treated by H. v. Meyer, Pomel, Rütimeyer, Owen, Major, Nehring, Woldrich, and many others and a great number of forms have been described, until, in 1886, Lydekker¹ provisionally grouped them under two headings: *Equus caballus* Linnæus, and *Equus stenonis* Cocchi. Thus matters stood when, in 1899, Boule,² in a most suggestive paper, pointed out that, in addition to these, a third species, *Equus robustus* Pomel, could be distinguished, which although approaching the *caballus* type, was, he thought, more nearly related to *stenonis*.

Since 1904 Professor Ewart³ of Edinburgh has taken up the subject with a view to elucidating the origin of domestic horses. According to his theory⁴ three types of domestic (and ancestral wild) horses can be distinguished; a "Plateau" variety including the Celtic pony and the Arab, which can be traced back to the Pliocene *Equus sivalensis*,⁵ a "Forest" variety typified by the heavy draught horses of continental Europe and descended from Pomel's *Equus robustus*, and a "Steppe" variety still found in a wild state in Mongolia, *Equus przewalskii*, which has influenced some of the races of European cart-horses. Some more recent papers by Soergel,⁶ Antonius,⁷ and Boule⁸ may be mentioned here; and finally an elaborate paper by v. Reichenau,⁹ in which a number of new species and two new genera are described, which however has more confused than cleared the subject.

¹ Cat. Foss. Mamm. B. M., III, pp. 69-71, 73-88, (1886).

² Bull. Soc. Géol. France, (3) XXVII, pp. 531-42, text fig. 1-22, [1899] (March 1900).

³ The most important of these papers are the following: Trans. Highl. Agric. Soc. Scotland, (5) XVI, pp. 230-268 (1904); Trans. Roy. Soc. Edinburgh, XLV, pp. 555-587 (1907); Science, (N.S.) XXX, pp. 219-223 (1909). Although I am compelled to state that his results are entirely wrong, yet I gladly admit that I owe many valuable suggestions to his papers.

⁴ Similar views are held by Doctor Duerst (Carnegie Inst. Publ., no. 73, vol. 2, pp. 339-446; 1908).

⁵ Or a nearly allied type which is called *Equus agilis* Ewart.

⁶ Neues Jahrb. Min., Beilagebd. XXXII, pp. 740-761 (1911).

⁷ Verh. k. k. zool. bot. Ges., LXII, pp. (64)-(78) (1912).

⁸ Ann. Paléontol., V, pp. 113-135 (1910).

⁹ Abh. Geol. Landesanst. Darmstadt, VII, pp. 1-155 (1915).

The evidence afforded by fossil bones and teeth found in Europe, Asia, and Africa appears to admit only two general types. In the species named *stenonis*, *atlanticus*, *persicus*, etc., the anterior pillar (protocone) of the premolars and molars is short (generally only one third of the total length of the tooth) with the anterior lobe scarcely developed and the interior margin mostly convex, straight or only slightly bent in at the middle. The enamel folds are moderately developed, the paracone and metacone are thick and their lateral surface convex, and the parastyle and mesostyle narrow and, if at all, only doubled in the anterior premolars. The eye sockets are somewhat projecting, and the angle of the lower jaw is deep. In the limbs the lower portions (radius-metacarpal and tibia-metatarsal) are comparatively long and narrow, the upper portions (humerus, femur) shorter than in the next species.¹⁰

In the other type to which such names as *caballus*, *phicidens*, *robustus*, *süssenbornensis*, *mosbachensis*, *przewalskii*, etc., have been applied, the anterior pillar of the cheek teeth is generally longer (usually more than one third of the total length of the tooth) with the posterior lobe always and the anterior one in many cases of considerable size, the interior margin being always bent in or even sharply divided at the middle. The enamel folds are more pronounced, the paracone and metacone distinctly lunate and their outer border concave, and the parastyle and mesostyle more imposing and doubled in most of the cheek teeth; the eye sockets are not projecting and the angle of the lower jaw is much less deep. The metatarsals and metacarpals are as a rule comparatively shorter and broader in specimens from older strata but about as slender as in the former species in more recent ones. The upper portions of the limbs (humerus, femur) are, however, somewhat longer compared to the lower portions (tibia, metatarsus, etc.).

It has hitherto been supposed that *Equus sivalensis* belongs to the first or *stenonis* type. But a renewed examination of Mr. Lydekker's beautiful plates¹¹ makes me believe that it is a member of the *caballus* series. The shape of the protocone, paracone and metacone and of the para- and mesostyle are decidedly of this type. This is still more so in *Equus namadicus* which is probably the direct descendant of *E. sivalensis* and apparently similar in the Ceylon tooth described by

¹⁰ Lydekker, Guide to the specimens of the Horse family, p. 26 (1907).

¹¹ Mem. Geol. Surv. India (Palaentologia Indica), (10) II, pl. XIV, XV (1882).

Wayland¹² as *Equus zeylanicus* and in *Equus leptostylus* Matsumoto¹³ from Honan, China. Lydekker has made a strong case of the presence in *E. sivalensis*, *E. stenonis* and the Arab of a preorbital depression; but since the same character is found in the southern but not in the northern local races of *E. quagga*, I cannot regard it as of specific value.

It has frequently been maintained that the horses of the second (*caballus-robustus*) type were derived from those of the *stenonis* group, chiefly on the assumption (1) that *stenonis* is older (Pliocene) (2) that in some of the older specimens of "*robustus*" only a rather small protocone is found in the cheekteeth. This is disproved however by a tooth from the Red Crag of Bawdsey, Suffolk,¹⁴ contemporaneous with or even older than *stenonis* and distinguishable, except in size, from the most recent teeth of *E. caballus* only in details discussed below. I am not quite satisfied whether the remains usually referred to *E. stenonis* and *robustus* respectively from the Oreston Cave near Plymouth, from Kent's Hole near Torquay, from the lower deposits at Mosbach near Wiesbaden, and from the older Auvergne strata are all found in the same horizon, but this is of little importance since the Bawdsey tooth¹⁵ is older than either of them. There is no doubt, therefore, that both species occurred together in Europe during upper Pliocene and probably also basal Pleistocene times.

I shall now designate the first of these types as *Equus stenonis*. The names *atlanticus*, *tigeris*, *mauretanicus*, *persicus*¹⁶ and *stenonis* decidedly belong to this species and may be races of it; their exact value and relation among each other I am not at present prepared to state. Remains of Pliocene age have been found at Maragha in northern Persia, in the Val d'Arno, Italy, at various localities in France, southern Germany, Austria-Hungary, and southern England; some, as those of Mosbach or the Norfolk Forest Beds as well as some of the British caverns, are early Pleistocene; the most recent materials appear to be those from northern Africa which have been described

¹² Spolia Zeylan., X, pp. 261-280 (1916); the tooth of *E. caballus* figured for comparison obviously belongs to an Indian domestic horse and is of the Arab or *stenonis* type.

¹³ Science Reports of the Tôhoku Imperial University, Sendai, 2nd ser. (Geology), III, no. 1, pp. 29-30 (not seen in the original; figure copied by Wayland).

¹⁴ Owen, Quart. Journ. Geol. Soc., XII, p. 223, fig. 12 (p. 233) (1856).

¹⁵ The exact age of these strata is probably upper Pliocene.

¹⁶ Wilckens, Anz. Ak. Wien, XXIV, p. 43 (1887), and Nov. Act. Leop., LII, p. 268, pls. XI, figs. 18, 19, X, figs. 21-24, XIII, figs. 43-46, XIV, figs. 47 (1887); from the lower or middle Pliocene of Maragha, Persia.

by Pomel, Ph. Thomas, Boule, and other French authors, and are in part from late Pleistocene deposits. There is, however, no doubt that everything found in continental Europe and especially in England is not more recent than early Pleistocene, about corresponding to the "first Interglacial" of Penck.

The modern Arab thoroughbred shows all the main characters of this type which have been pointed out above; in addition it possesses only five lumbar vertebræ, a feature not hitherto corroborated in fossil material, the available skeletons being of a very fragmentary nature. But there is ample reason to believe from the facts known that it is from this type that the Arab, Barb, and the high-bred "Oriental" races have been developed. Since it has been shown that *E. sivalensis* is distinct it becomes highly probable that the thoroughbred races have been bred from the North African race of *Equus stenonis* which in a wild state survived up to the human period.

The second type, which should be known as *Equus caballus*¹⁷ (including a very great number of names the exact status of which is not yet determinable), first appears in the Pliocene Red Crag of England and the upper (upper Pliocene) deposits of the Sivalik Hills and is still found in a wild state in Mongolia. From the oldest to more recent forms a gradual decrease in size seems to exist which leads from the large tooth from the Red Crag figured by Owen as *E. plicidens* and the coarse limb bones mentioned by Lydekker¹⁸ as belonging to a very large species, to the small light-limbed horses of late palæolithic and neolithic times and Przewalski's horse of Mongolia. It would appear that this evolution has not taken place in a continuous series in at least those parts of western Europe which underwent glaciation, had their fauna destroyed by the ice and only in "interglacial" and post-glacial times regenerated from districts where it had been preserved. This assumption would explain the gaps between the large preglacial *E. c. plicidens*, the middle sized second stage (*E. c. robustus*) and the small third stage of the *E. c. spelæus-przewalskii* type. At present only in one case¹⁹ have transitional stages been described, and these

¹⁷ Fixed by Ewart (Trans. Highl. Agric. Soc. Scotland, (5) XVI, p. 264, on the Norwegian "Fjordhest." I cannot agree with Stejneger (Smith. Misc. Coll., XLVIII, p. 470; 1907) that Fitzinger (Ab. Ak. Wien, XXXI, pp. 139-212; 1858, XXXII, pp. 391-420; 1858, XXXV, pp. 335-36; 1859) should be regarded as first reviser, as he mixes up both types under his *E. caballus*.

¹⁸ Cat. Foss. Mamm. B. M., III, p. 89 (1886); from the Norwich Crag.

¹⁹ Soergel, l.c.; from Steinheim a.d. Murv, Württemberg.

are from an area which has remained free from ice during the whole Pleistocene. This gradual evolution may be observed in another important character; in the older forms the protocone of the cheek teeth is somewhat detached from the main body of the tooth and becomes more adpressed in more recent ones; the anterior lobe of the protocone is on the whole rather long and has been described as very characteristic of *E. c. przewalskii* by Lydekker;²⁰ it appears to be constantly so in the living and the more recent fossil forms, but in teeth which have been described from the lower Pleistocene of central Europe it is sometimes much smaller than the posterior lobe (from which it is generally clearly separated), though this is far from being constant, even in teeth from the same locality. The oldest tooth known (Bawdsey) is almost indistinguishable in this particular character from the most recent types.

It is this type, with a rather heavy head and six lumbar vertebræ, that has transmitted its principal characters to modern heavy races such as the "Pinzgauer" and "Belgian" draught horses. Their far superior size compared to that of the wild "tarpan" is most certainly the product of conscious breeding for certain purposes which has taken place in historical times and even within a rather short period. It has frequently been supposed that the most heavy types are derived from the middle sized horse of the "*robustus*" type, but this is impossible as that form had long ceased to exist at the time when horses were first domesticated. On the contrary all the available evidence afforded by fossil and prehistoric remains points to the fact that the most ancient domestic horses were of a type closely resembling the wild tarpan of Mongolia in their rather light build and somewhat clumsy head.

Professor Ewart believed that the "Celtic" pony is of another type than the tarpan. It has been already shown by Lydekker²¹ that the skull characters adduced by him are not very reliable, and it has also been shown above that slender limbs are found in *E. stenonis* as well as in the more recent forms of the *caballus* type. It would further appear probable that the presence of only five lumbar vertebræ in some of the skeletons examined by Professor Ewart is due to infusion of southern blood;²² I have ascertained²³ that the Lofoten pony preserved in the Bergen Museum and regarded as of pure Celtic origin

²⁰ Guide to the specimens of the Horse family, p. 14, fig. 16A (1907).

²¹ "Guide," p. 15.

²² Ridgeway, The Origin and Influence of the Thoroughbred Horse, pp. 419-420 (1905); and Lydekker, The Horse and its relatives, p. 121 (1912).

²³ With the kind help of Professor Brinkmann.

both by him and all those who have examined it, has six lumbar vertebrae. I should think that the original "Celtic" pony was of "northern" blood, and that the "southern" characters presented by a number of the present ponies are entirely due to mixture with horses imported from the Mediterranean region within historic times.

The remarkable fact that in Europe alone both species of horse were found together, will be understood by the following zoögeographical deductions. In the later Tertiary, Europe had a land connection with North Africa as well as western Asia, immigration being possible both from the East and South. Thus *Equus stenonis* reached Europe from northern Africa as a representative of the western or Mediterranean, *Equus caballus* from central Asia with the eastern or Asiatic component of the Pliocene steppe fauna. During the Glacial Period the greater part of both faunae disappeared from central Europe. But when the ice had made its retreat, the Mediterranean landbridge was no longer in existence, and reimmigration was possible only from the East. In postglacial times *Equus caballus* ranged again all over northern and central Asia and the greater part of Europe and has given rise, through its various geographical subspecies, to the primitive domestic races of Russia and Asia and the heavy draught horses of western Europe. *Equus stenonis*, however, was held back in northern Africa where it has become the ancestor of the thoroughbred stock of Barbs and Arabs.²⁴

Frankfort a. M., Germany.

²⁴ It is interesting to note here that a tooth from Wadi Halfa, Nubia, described by Lydekker (Quart. Journ. Geol. Soc., XLIII, pp. 161-63; (1887), as nearly related to *E. sivalensis*, appears to me quite different. If conclusions may be drawn from a single specimen, it seems to approach *E. quagga* more than anything else.

BATS FROM NEW MEXICO AND ARIZONA

BY GLOVER M. ALLEN

Due to the generous interest of Col. John E. Thayer and Dr. Thomas Barbour, the Museum of Comparative Zoölogy has lately received a number of bats from New Mexico and Arizona a few notes on which seem worth recording. They were obtained chiefly by Messrs. Wharton Huber and R. D. Camp, the former while collecting in the vicinity of Las Cruces, New Mexico, for Colonel Thayer, and Mr. Camp during an expedition to the desert ranges of the Huachuca, Oro Blanco, Cayetano, and Patagonia Mountains of southeastern Arizona. The following ten species are represented.

***Macrotus californicus* Baird**

CALIFORNIA LEAF-NOSED BAT

This species is well known to inhabit the hotter portions of southern California and Arizona. Rehn (1904) has recorded specimens from Tombstone, Arizona, and there is a specimen in the United States National Museum from near Tucson. The Camp collection contains fifteen of these bats, captured in a deserted mine tunnel, January 24, in the Cayetano Mountains, Arizona, at 4000 feet altitude. All but two were adult females. According to Mrs. Grinnell's observations in California, it seems likely that this species is somewhat migratory; at least, they withdraw in winter from certain localities where they were found in spring and summer. Two other specimens are from Superior, Arizona.

***Choeronycteris mexicana* Tschudi**

LONG-NOSED BAT

An adult female secured by Mr. W. W. Brown in the Huachuca Mountains, September 27, 1920, is apparently the second specimen to be taken within the United States. The other record is of one captured in the Chiricahua Mountains, eight miles west of Paradise, Arizona, August 17, 1904 (see Miller, 1906). A comparison of our specimen with a female from Morelos, Mexico, reveals no important differences, though the skull of the former is a trifle the smaller. It is interesting in possessing on the right side of the upper jaw, a persistent milk tooth, directly behind and in contact with the canine. The

retention of this short recurved spicule is probably to be correlated with the length of jaws and the consequent uncrowded condition of the small teeth, thus allowing sufficient room to prevent the milk tooth from being pushed out.

Elliot in his *Land and Sea Mammals of Middle America* (1904) calls this the "Tres Marias Island Bat," but the supposed record for these islands turns out to be erroneous, as the species was really *Glossophaga mutica* (see Nelson, 1899, p. 14).

***Myotis velifer* (J. A. Allen)**

CAVE BAT

Mr. Camp captured two males of this species on April 20 in Montezuma Cañon, Huachuca Mountains, at 6000 feet altitude.

***Myotis occultus* Hollister**

HOLLISTER'S BAT

Hitherto this rare species has been found only on the west side of the Colorado River in extreme southeastern California. Hollister's two specimens were taken ten miles above Needles, San Bernardino County, May 14, 1905, and later, in May, 1910, six additional examples were collected by an expedition from the University of California. I have now to record it for the first time from New Mexico, where Mr. Huber obtained a female, May 23, 1920, three miles west of Las Cruces, on the Rio Grande. It was shot after dusk, as it flew through an orchard and under some large cottonwood trees. Two other bats, shot at the same time, and perhaps of the same species, could not be found. Dr. Joseph Grinnell, whose expedition obtained the six specimens noted above, suggests that this species is a late spring arrival in the region where it was found, since his party, "although collecting along the Colorado River from February 15 until May 15, failed to detect this bat until the first week in May." It will be seen that Mr. Huber's specimen was captured late in the same month, also. Perhaps it may be late in coming out of hibernation, rather than a late migrant from any considerable distance southward.

This species is remarkable among the North American *Myotis* in that the upper middle premolar (pm^3) is in process of becoming lost. According to Mrs. Grinnell (1918, p. 262), this tooth is absent from both sides of the upper jaw in four of the eight known specimens. In the

specimen from Las Cruces, however, it is absent on the left side only. Here the anterior premolar (pm^3) as if taking advantage of the loss of the middle one, is noticeably larger than the anterior premolar of the opposite side and stands fully in the tooth row so as to fill the space completely between canine and last premolar (pm^4). On the opposite (left) side, the anterior premolar lies just inside the axis of the tooth row, while the middle premolar (pm^3), much smaller, is forced even more inward.

This tendency to lose certain of the teeth is seen in many and very remotely related species of bats. It is not necessarily a result of the gradual shortening of the tooth row to produce greater crushing power for as in the Las Cruces specimen, the anterior premolar of the right side filled the space of two on the opposite side. The frequency with which the middle premolar is missing in this species indicates that the upper dentition is now in course of evolution from a three-premolar to a two-premolar stage. Apparently, to judge from the available specimens, the latter, more reduced condition has made such headway as to be now as frequent as the three-premolar stage. Should it eventually prevail within the species, the normal dentition would then have the same formula as in *Lasionycteris*, *Corynorhinus*, and certain other genera, so that it might come to be placed in a genus distinct from *Myotis*. Thus we may have in *Myotis occultus* a genus in the making, a species now referred unhesitatingly to *Myotis*, but which, if the loss of the middle premolar became permanent, would perhaps come to be regarded as a monotypic genus, characterized by its reduced dental formula.

Pipistrellus hesperus (H. Allen)

WESTERN BAT

This little whitish species with its black contrasting membranes, is confined more or less closely to the Great Basin. Although probably common locally, there is but one specimen in the collections here reported on, a male taken October 1, on the west side of the Organ Mountains, New Mexico, by W. Huber.

Eptesicus fuscus (Beauvois)

LARGE BROWN BAT

At Las Cruces, New Mexico, Mr. Huber found a considerable colony of this common and widespread species living in the roof of a building

where by a narrow crack they gained entrance to the space above the ceiling. Here, on June 28, he collected 23 specimens by dislodging them from their retreat. Of these, 15 were adult females, and the rest were well-grown young, probably at least a week or two old, the largest with short hair, and nearly a third adult size. Curiously, all but one of these eight young were males. The absence of adults of the latter sex may indicate that there is a segregation of the sexes at this season. A few were also found with a colony of free-tailed bats in a cave 15 miles northwest of Las Cruces, New Mexico, (opposite Shalem Colony). "The cave is about 50 feet deep by 30 feet wide, 16 or 18 feet high at the entrance, the roof sloping back to the floor in the rear. It is evidently of volcanic origin as the whole face of the hill is black and looks like lava. An arroyo rises at the entrance of the cave. The floor is covered with bat guano to the depth of a foot or more in places. Several of these bats were driven from crevices in the cave but managed to hide so that they could not be located again."

Sharing the cave with the brown and free-tailed bats, were ten pairs of cliff swallows with their mud nests attached to the ceiling near the entrance. A great horned owl was collected in the cave.

Nycteris cinerea (Beauvois)

HOARY BAT

Very little is definitely known of the breeding range of the hoary bat. In the eastern United States it is generally believed to be a migrant only; or from the Carolinas southward, a wintering species, breeding probably in Canada and perhaps the northernmost of the states. For California, however, Mrs. Grinnell (1918) supplies three July records out of a total of 55 for that State, and these three are all of adult males. In Mr. Huber's collection are two adult females which he found hanging in willows, five miles west of Las Cruces, New Mexico (3800 feet altitude), both on August 27, 1920. The discovery of two at the same locality on this date, suggests that they were early migrants just arrived from the northward. The same trees had been carefully searched for warblers the day before. Yet there is also some evidence that the species is present all summer in parts of the Southwest, for Mr. Camp's collection contains an alcoholic male from the Huachuca Mountains, taken June 26, at an elevation of 5200 feet. In addition, W. W. Price reported it "not uncommon" in the Huachuca Mountains during the

summer of 1893 (J. A. Allen, 1895, p. 247); and Attwater took one at Cubbra Springs, 18 miles west of San Antonio, Texas, in the early summer of 1891 (J. A. Allen, 1896, p. 71). I am unable to distinguish Camp's Huachuca specimen, or Huber's Las Cruces females, from others taken in eastern United States.

***Corynorhinus rafinesquii pallescens* Miller**

PALLID LUMP-NOSED BAT

Colonies of these big-eared bats seem to be scattered and of relatively few individuals. Mr. Huber did not obtain the species at all during his stay of several months in New Mexico. In Arizona, however, Mr. W. W. Brown secured a female, September 30, in the Huachuca Mountains, and Mr. Camp collected fourteen of both sexes in the same range at different dates between March 28 and May 11, altitudes varying from 5200 to 7800 feet. Of twelve taken February 7, in the Oro Blanco Mountains, Arizona, (4600 feet) all but two were females. A similar disproportion of sexes in the colonies, one way or the other, is recorded by Mrs. Grinnell in her excellent summary of the habits of this species in California.

***Antrozous pallidus* (Le Conte)**

PALLID BAT

In late July, Mr. Huber found well-grown young in colonies of this species at Las Cruces and Mesilla Park, New Mexico. At the former locality, five adult females and nine young were taken July 16 from behind the window casing of an abandoned sanitarium; and four days later at Mesilla Park, seven adult females and five young were captured from a colony of some 200, living in the spaces above the doors of an old alfalfa barn. The young bats were nearly full grown but in color the back is more dusky than in the adults, and the buffy tinge is lacking. The absence of adult males in the catch may indicate that they were keeping apart at this season. Mrs. Grinnell records a similar segregation on the part of the Pacific pallid bat in California. Mr. Huber also captured on June 8, at Beveno, an adult female, the only one apparently, in a large colony of free-tailed bats inhabiting a crevice above a barn door.

Nyctinomus mexicanus (Saussure)

MEXICAN FREE-TAILED BAT

This is probably the most abundant bat in the territory under consideration. As is well known, it is highly gregarious, living in colonies often of large size. So ready is it to take advantage of the shelter offered by human habitations, that colonies are more often found in the recesses of a roof than in caves, the primitive habitation. Mr. Huber discovered one cave fifteen miles northwest of Las Cruces, New Mexico, that was inhabited by this species. Twelve individuals taken at random here on June 2, proved to be all adult females, each with a good-sized fetus. At Bevinio, there was a large colony living in the hollow space beneath a roof, entrance to which was gained through a crack over a door. Mr. Huber gathered 67 here on June 8, of which about one fourth were adult males, and the rest adult females, each containing a single fetus. In nearly every case the fetus was large and would probably have been mature in another week; a few, however, were smaller than the rest, while one or two were larger and seemed almost ready for extrusion. On the whole, however, the size of the embryos was rather uniform and indicates that in this colony at least, the breeding season is at a quite definite time. In most cases the fetus was carried transversely to the main axis of the body, with the head at the right-hand side, directed forward, and the little wings folded over the face.

The disproportionately small number of adult males seems typical of a breeding colony of this species. Mrs. Grinnell records a colony examined in San José, California, on February 2, in which the proportions of the sexes were about equal in clusters found behind the iron window shutters on the *west* side of a building; while on March 3, of 35 specimens from behind shutters on the *east* side of the same building all were females.

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Cambridge, Massachusetts.

THE VALIDITY OF THE PENOBSCOT FIELD MOUSE

BY LELAND C. WYMAN

In December, 1901, Mr. Reginald Heber Howe, Jr., described a new subspecies of *Microtus pennsylvanicus* which he had collected on Tumble Down Dick Island in Penobscot Bay, Maine, naming it *Microtus pennsylvanicus shattucki*.¹ There has been some doubt among mammalogists as to whether or not this form really differs from the ordinary meadow mouse of the mainland. Following are the results of a careful comparison of the type specimen and other skins of *M. p. shattucki* with about two-hundred skins of *Microtus pennsylvanicus* (Ord) in the collections of the Lee Museum of Bowdoin College, the Museum of Comparative Zoology of Harvard University, and various private collections. The specimens of *M. p. shattucki* which were examined consisted of the type and seven others of the original series from Tumble Down Dick and Ilesboro, Maine, now in the museum at Harvard and in the collection of the Boston Society of Natural History. These are the only specimens from the type locality which could be located. Others may exist in private collections. The specimens of *Microtus pennsylvanicus* used in the comparison were collected from four localities in Maine; three islands of the Maine coast; Grand Manan Island, New Brunswick; one other locality in Canada; three localities in New Hampshire; eleven localities in Massachusetts; seven islands near Cape Cod, Massachusetts; two localities in Rhode Island; one locality

¹ A New Race of *Microtus pennsylvanicus*. Reginald Heber Howe, Jr. Proc. Portland Soc. Nat. Hist., vol. 2, part 6, p. 201. Portland, Maine, December 31, 1901.

in New York; one in West Virginia; one in North Carolina; and (three topotypes) in Pennsylvania.²

The subspecific characters given in the description are: "One of the largest of the *Microtus pennsylvanicus* group. Tail very long, ears prominent, bullæ very large and globular, palatine foramina markedly broad and bottle shaped, coloration as in *M. p. pennsylvanicus*, except perhaps slightly darker." I shall take up these characters one by one.

SIZE

The description gives the total length of the new subspecies as ranging from 176 to 198 mm., and that of *M. pennsylvanicus* from 167 to 171 mm. (taking these measurements from Elliot's "Mammals of North America"). Although this is the average range of the length of the meadow mouse it is not uncommon to find specimens measuring from 170 to 200 mm. Of the measurements of the specimens examined, 11.3 per cent of the whole number were between 190 and 200 mm., 20 per cent were between 180 and 190 mm., and 28.8 per cent were between 170 and 180 mm. The remaining 40 per cent were below 170 mm. Two specimens from Massachusetts and one from Raleigh, North Carolina, were over 200 mm. in length. The total lengths of the eight specimens of *M. p. shattucki*, taken from Howe's measurements, were 138.4 mm. (2), 165.1 mm. (2), 168.1 mm., 187.5 mm., 190.5 mm. (type), and 201.5 mm. With the exception of two specimens these measurements are well within the average range for *pennsylvanicus*. Meadow mice from the islands off the New England coast are large as a rule. The series from Grand Manan, New Brunswick, which I examined were at the upper limit for the size of the species.

EARS

It is difficult to tell much about the ears of dried skins, owing to their shrunken condition. Those of the skins of *M. p. shattucki* did not appear to be any different from those of skins of meadow mice from a great variety of localities. Five of the specimens were collected in July, one in August, and one in September. In summer pelage the ears of meadow mice are usually conspicuous above the fur, so this fact may account for the statement that the ears are prominent. Such a char-

² I am indebted to Prof. Manton Copeland of Bowdoin College for suggesting the comparison and to Dr. Glover M. Allen of Harvard University for the loan of skins and skulls.

acter should not bear much weight in an animal as variable in minor details as the meadow mouse.

COLORATION

The color of the meadow mouse is due to a mixture of yellowish rusty and blackish hairs, the relative abundance of which determines the particular shade. In a large series of meadow mice there is a great variety of fine gradations of color from very pale, yellowish specimens to those which are dark brown or blackish. Many from the mainland of New England are almost black in color. The series of *M. p. shattucki*, when compared with a series of three hundred skins from a great variety of localities, were seen to be in about the middle of the range of color variation. They are rather bright with a large proportion of yellow and reddish hairs, being almost identical in color with specimens from various localities in Massachusetts, and distinctly lighter than many others also from Massachusetts.

AUDITAL BULLÆ

Upon superficial examination there appears to be no noticeable difference between the bullæ of the skulls from Tumble Down Dick and of those collected in various places in New England. A skull from Wareham, Massachusetts, was seen to be almost an exact match in every particular for the skull of the type specimen of *M. p. shattucki*. The skulls of the series from Grand Manan are comparatively large and heavy and the bullæ are large in proportion, appearing to be more globular than those of *shattucki*. For purposes of comparison the greatest length and the greatest width of the right bullæ of the seven skulls of *shattucki* and of ninety-six skulls of *pennsylvanicus* were measured to the nearest hundredth of a millimeter by means of calipers and a micrometer. The dimensions of the bullæ of *shattucki* ranged from 7.32 by 5.75 to 8.85 by 6.63 mm. Those of *pennsylvanicus* run up to 9.41 by 7.00 mm. The average dimensions of the right bullæ of fifteen specimens from Grand Manan is 8.53 by 6.43 mm. In order to obtain a quantitative expression of the globularity of the bullæ, the width was subtracted from the length in each case, and the result was divided by the length. This gave an index of the ovalness of the bulla which would be smaller in the case of more globular and larger in the case of less globular bullæ. The indices thus obtained were grouped into nine magnitude classes and the classes were numbered in order. Class

4 contained the greatest number of variates, thus being the mode. The indices of three of the specimens of *shattucki* fall into this class, three into class 5 and one falls into class 6. This constitutes quantitative proof that the audital bullæ of *M. p. shattucki* are not more globular than the average bullæ of *M. pennsylvanicus*.

PALATINE FORAMINA

The palatine foramina of meadow mice vary greatly in size and shape. Many are seen in skulls collected from various places which appear to be as broad as or broader than those of *M. p. shattucki*, especially in large skulls such as those of the Grand Manan series. The length and greatest width of the palatine foramina of eight skulls of *shattucki* and of 103 skulls of *pennsylvanicus* were measured with calipers. The dimensions of those of *shattucki* range from 4.57 by 1.35 to 6.10 by 1.56 mm. The width of the foramina of *pennsylvanicus* run up to 1.79 mm. The average dimensions of the Grand Manan series are 5.89 by 1.52 mm. The expression "bottle shaped" is an obscure one to deal with quantitatively. This character may best be expressed as an index by dividing the length by the greatest width, giving a number which would be smaller in the case of more bottle shaped foramina. This was done for each specimen measured and the results were grouped into eleven magnitude classes, class 5 constituting the mode. Of the indices of *M. p. shattucki*, three fall into the mode, three into class 6 and one each into classes 3 and 4, proving quantitatively that the palatine foramina of *shattucki* are not broader in proportion to their length than the average foramina of meadow mice, and hence cannot be considered more bottle shaped.

TAIL LENGTH

The tail length of the new subspecies is described as ranging from 54 to 62 mm., while the average range of tail length of meadow mice is given as from 44 to 46 mm. The recorded measurements, taken in the flesh, of 186 specimens of meadow mice range from 30 to 60 mm. The tail lengths given in the records with the skins of *M. p. shattucki* fall well within this range with the exception of two specimens, both of which are recorded as 63.5 mm. It is not uncommon to find meadow mice with tail length well up to 60 mm., and where only two specimens range slightly above this, it seems hardly plausible to base a subspecies on such a character. There is a possibility, also, that the records on

the labels are not correct. The tails of the skins of *shattucki* were measured with calipers and found to be from 6.1 to 17.8 mm. shorter than the recorded measurements. Of course it is impossible to say anything about the dimensions of an animal in the flesh from measurements of the dried skin, but as a rule the technique of skinning causes the tail to be stretched if anything. To test this the tails of 80 skins made up by a number of different collectors were measured and compared with the measurements of the same animals taken in the flesh. In 50 per cent of the cases the tails were from 0.5 to 13 mm. longer than the lengths recorded and in 12 per cent they were the same. It does not seem probable that the tails of the *shattucki* series would have shrunk so consistently.

CONCLUSION

The comparison described above showed no essential differences between the Penobscot field mouse and the common meadow mouse of the mainland. In all of the characters mentioned in the description as being subspecific, the specimens of the *shattucki* series lie within the range for *Microtus pennsylvanicus*. In view of the constantly increasing complexity of the classification of mammals it would seem well to exclude the subspecies *shattucki* from a revised list of species in the genus *Microtus*.

Boston, Mass.

THE EVOLUTIONARY FORCE OF A WIDE RANGE

BY ERNEST THOMPSON SETON

(It is with considerable hesitation that I offer this paper on a subject that is somewhat out of my usual line. I do so on the advice of my friend, Dr. Joseph Grinnell, of Berkeley, California, as he assures me it will be found new and important, and that I should certainly put it on record.)

In 1892, I corresponded with a Russian naturalist, Baron Max von Sivers, of Roemershof, Riga, Livonia, who represented a group that intended to introduce the wild turkey into Livonia. Though in sympathy with their purpose, I took a pessimistic view of its feasibility, and, in a brief paper, pointed out a principle involved that seems nearly self-evident when one arrays the available facts.

This principle I have often referred to in my writings since, and elaborated in my lectures, but have not hitherto offered for record in formal scientific print. Therefore I now reproduce that paper.

The theory is briefly this: *Other things equal, a species evolved in a large area, is stronger than one evolved in a small area.* Obviously, the chances of superior variants appearing are greater in a large population than in a small one. And further, a race that can adapt itself to the many vicissitudes of a large range is stronger than one that is fitted to the less vicissitudes of a more limited space. Evidently a big fire is hotter in the middle than a little fire.

The largest existing land-area, for a species that can freely traverse mountains and rivers, is Eurasia. Therefore, if my theory be right, a Eurasian species will speedily overcome an American species, or an Australian species. Witness the triumphant march of the house-sparrow, the starling, the brown rat, the house-mouse, the mongoose, the fruitbat, the carp, the brown trout, the browntail and the gypymoths, etc., many weeds and even trees.

These, being Eurasian, have been specialized in so many ways, and hardened in so many more fires and forces than our own kindred species, that they are stronger, hardier, more adaptive, less subject to disease, more resistant, more aggressive, more frugal, more prolific. And they march ever on, possessing and destroying, even as the white man himself has done. Significant illustration is seen in the facts that the Asiatic chestnut is immune to the blight that is destroying the American, and the Caucasian pine is proof against the blister-rust that is filling American foresters with dismay.

All attempts to implant our ruffed grouse in the old world have been utter failures; on the other hand the Hungarian partridge and the Mongolian pheasants are immediately successful here.

Not only is a species of Eurasian evolution stronger than one of American; but an American is stronger than an Australian; an Australian is stronger than a New Zealander; and an African is stronger than a Madagascan species. Indeed, a continental species always is stronger and bigger than an insular form; and creatures evolved in small islands wither away before the invading Eurasians like pine boughs in a flame. For example, note the dodo of the Mauritius, and the ground-pigeon of Samoa, and possibly also our own wild pigeon.

It seems to be nearly self-evident that all of the dominating land animals in North America today are of species that have close kin, and apparently their parent stock, in Eurasia. They probably invaded this area by way of the northwest land-bridge; for example, the coyote, gray-wolf, fox, mountain-sheep, moose, white bear, otter, weasel. And the species that cannot hold their own, as attested by paleontology, were those evolved in this region.

It is pretty well established that as a rule species increase in size as they evolve, and are at their maximum when their race disappears, i.e., great size is proof that they have gone far along the trail.

This rule is evidenced by the fact that the recent or living American cats, camels, horse, sheep, bison, wild hogs, horned owl, ostrich, etc., are smaller than those of the older, bigger world.

If however the giant fox of South America is of the genus *Vulpes*, then it is an exception to the rule I am trying to formulate. If it is obviously of another genus, it is not an exception, and further foreshadows with certainty the finding of extinct giant foxes in Eurasia. The same remarks and prophecy apply to the condor and the harpy eagle.

If we compare the gerboas of Africa with the nearly parallel kangaroos of America, we find that the former, with their wide range, have gone much further in evolution than the latter with their limited range. I doubt not that a few thousand African gerboas released in our southwest would, by mere pressure of better equipment, drive all our dipodomys to extinction, and possess their range.

Conversely, no American species has ever been able to establish itself in Eurasia, no Australian species has ever conquered Eurasia or America, no New Zealand species has ever successfully invaded

Australia, no species of Madagascan evolution, has ever established itself in Africa.

My sad contention, then, to my Russian friends, was that the American wild turkey would stand no chance of success if introduced into a Eurasian environment, to compete with the highly equipped native species.

As apparent exceptions one recalls the canal weed, (*Philotria canadensis*), an American species running riot in England; the water hyacinth of South America becoming a nuisance in Florida; maybe also the muskrat which is said to be possessing parts of Europe.

I suppose that the answer is that the rival species these invaders must combat in their new homes, were evolved in small, isolated sections of their larger motherland, in some way hedged about by an impassable barrier. They had not really a continent-wide dispersal, so were not subject to the urge of a wide environment, and, therefore, are not exceptions to the principle of the law.

The great land centre of evolution is Eurasia, and it will continue to turn out the successful species, as long as it continues to be the greatest unbroken land area, a thought that is not without its measure of warning to the human species, when one recalls that, in a rigid application of this law, the Oriental races are bound to inherit the earth.

Greenwich, Connecticut.

HABITS OF SOME WEST COAST SEALS

BY A. BRAZIER HOWELL

Recently, I had occasion to look up information on certain seals in the classical works by Scammon and Allen and I find that some notes I have on the habits of two of our southern California species may prove of interest.

Practically all of my notes on the pinnipeds were made before I took an active interest in mammals, but I had some little opportunity to become familiar with them, for, while working in 1910 with the International Fisheries Company in Lower California, Mexico, I spent two months, with a dozen Yaqui Indians, on Los Coronados Islands. Seals of two species were abundant, and as our constant diet of fish and spiny lobsters soon palled, we began weekly visits to the rookeries to obtain fat yearlings. In addition, I made many other trips to the different islands, and spent many an hour watching the herds from hidden retreats.

The California sea lion (*Zalophus californianus*) is abundant in the coastal waters of southern California, but to me, it has always seemed a sluggish, rather uninteresting animal which hardly repays protracted watching. An hour or two spent in a rookery will reveal little but basking animals, some occasionally slipping into or out of the water, and the proper complement of pups nosing about in a stupid manner. On June 3, 1910, the pups—two score of them—were a week or more old and when we suddenly rushed the colony to obtain a yearling before he could slip into the water, the younger animals were not greatly concerned as long as we approached no nearer than about fifteen feet. They presented, when beating a retreat, a most ludicrous appearance, for their efforts were out of all proportion to the speed attained, and they worked so hard, and progressed so slowly, that they seemed almost to be jumping up and down in one spot. When we laid hold of one, it emitted a loud, staccato bleating, comparable to the noise made by certain exotic goats which I have heard in zoological parks. The pups readily take to the water at this age, but their swimming is poor and their actions in this direction quite similar to those when "running" on land. In fact, it was so apparent that immersion in a rough sea at such a tender age must prove fatal to many, that we molested them as little as possible thereafter. While we were in the rookery, the females exhibited considerable anxiety, racing back and

forth at a distance of a hundred yards from shore and frequently leaping entirely out of the water in graceful curves.

The killer whale (probably *Orcinus ater*) is not rare in these waters and must take considerable toll of the seals. I also suspect the huge sharks, locally known as "leopard sharks," of a similar dietary taste. It is said that these big fellows, appearing to be at least eighteen feet long in some cases, are transient visitors from the south, and spend a week or more in the cold waters about the islands in order to free themselves of certain parasites. I can answer to the fact that they furnish rare sport with the harpoon.

At occasional spots on the islands, there occur caves which are popularly known as blow-holes. The entrances to these are chiefly below water, but, at certain stages of the tides, the top of the entrance is above water in the trough of a swell, and below at the crest. When the latter condition obtains, there is considerable pressure exerted upon the air in the cave, and this rushes forth through the wave with a booming noise, sending the spray high in the air—at one spot of which I know, as high as fifty feet when the trades are blowing strong and causing large swells. California sea lions delight to enter these caves to bark for half an hour at a time, and the resultant racket produces some weird accoustic effects.

The Yaquis, being pearl divers from the Gulf of California, were almost amphibious themselves, and constantly slipped over the sides of their cumbersome canoes, dug from a single log, to investigate the bottom for signs of spiny lobsters and fish. On two such occasions, the men were approached by seals, which exhibited the greatest astonishment and curiosity at finding such strange creatures in the water.

The California harbor seal (*Phoca richardii geronimensis*) is found about the islands, but in far smaller numbers than its larger relative, and the two genera apparently shun each other. In a shallow, rocky cove on the seaward side of the larger middle island of Los Coronados group, there is a hauling-out ground where about twenty-five of these animals could usually be found, and I spent considerable time in their company. A favorite position for them, and one which would seem to be the height of discomfort, was on a little pinnacle of rock, not over a foot in diameter at the top, and this was rarely unoccupied except at high tide. A seal would balance on this amidships, with every evidence of extreme satisfaction, head hunched in as when resting, fore flippers close to his sides, and rear ones extended straight out behind. There he would stay until dislodged by a companion or

washed off by the rising tide. He would remain just as long as he was able, and as the tide rose and each wave snatched at him, he would jerk both extremities of his body as far from the water as possible, looking like some queer, animated toy.

I was lucky enough, one day, to surprise five or six yearlings in a large, isolated tide pool that was a veritable gem of a sea garden. Here I kept them for ten or fifteen minutes while I watched their graceful movements. They swam at relatively great speed near the bottom of the pool, rolling their large eyes at me and dodging when I waved my arms. I was surprised to find that they did not use the fore flippers when swimming but kept these closely pressed to the sides, while the hind ones, placed "palm to palm," were moved rhythmically from side to side after the manner of a fish's tail, and furnished the sole means of propulsion. When a quick turn was desired, however, a fore flipper was extended and literally pushed against the water, as a running child might push with his hand against a wall to make a quick dodge. When pressed for air they arose to the surface for an instant, and then submerged with the celerity of a grebe. One dashed from the pool and made for the sea, but became wedged between two rocks, where I promptly laid hold of his rear flippers and, with considerable difficulty, hauled him forth. But he did not play fair, for he ejected a vile, excrementitious brew upon me, whereupon I incontinently released him and departed elsewhere.

These animals are much more wary than their larger cousins, and, at least when on the alert, they have a curious mode of submerging. While I was watching the individuals in the pool the remainder of the animals were a short distance off shore in a great state of excitement. Each one at times rose high out of the water, "stood" straight up, stared a moment, and then, by violently slapping one flipper on the surface, and probably raising the other through the water at the same time, submerged sideways as quick as a flash.

The above observations on the harbor seals were made on, or prior to, June 22; and at that date no young pups were in evidence.

Pasadena, California.

REMARKABLE CHANGES IN THE SKULL OF AN AMERICAN
BADGER (*TAXIDEA TAXUS*) DUE TO ADVANCED AGE

BY DR. R. W. SHUFELDT

[Plate 10]

While recently engaged in comparing the skulls of certain American mustelines and one from Hungary, namely the skull of a specimen of the European badger (*Meles meles*), with the view of preparing a brief monograph on the subject, I met with the skull of an American badger among the material kindly loaned me by the United States National Museum for this purpose, which seems to be worthy of special description. This skull is numbered 22253, but carries no data on its attached label beyond the statement that it is the skull of a specimen of *Meles taxus*. If *Meles taxus* stands for the European badger, this diagnosis is an error, as the skull is from an aged specimen of an American badger—*Taxidea taxus*. Each and all of its characters have been compared by me with the corresponding ones as presented in the skull of a very large American badger and the aforesaid skull of the European species (*Meles meles*), No. 171964, Hungary Acad., C. Jones.

The skull from the American one belonged to a very large specimen collected by W. S. Wood on the Republican Fork of the Platte River, on the 28th of September, 1856 (227), and carries the number of the National Museum of 2572 (♂). Beyond the loss of the left hamular process of the post palatine, it appears to be perfect in all particulars. As in a number of our mustelines, when they grow old, the mandible is nearly permanently locked to the cranium at either of its articulations,—that is, by the anterior and posterior articular eminences of the glenoid fossæ of the temporals at the posterior termination of either zygomatic arch. This locking, which is complete in many instances, occurs in various species, or rather in the skulls of old animals of our American forms, and has long been known; but whether it is ever seen in the skulls of badgers of the Old World I am not informed, though I am inclined to believe that it does not. It is not seen in the skull of *Meles meles* at hand, which came from an animal long adult.

Turning to the skull here to be compared and described, it is found to have an extreme length of 12 cms., and an extreme width (inter-zygomatic) of 8 cms., as compared with the skull No. 2572, which presents corresponding measurements of 12.3 cms. and 8.3 cms. The European badger (No. 171964) possesses a long and narrow skull

having an extreme length of 12.3 cms. and a width of only 6.3 cms. In general form, measurements, and facies, it has more the appearance of the skull of a very large Marten (*Martes americana*) than that of our badger, and it will not be further considered in the present connection, as its full description will appear later on, when the characters of all the skulls of the mustelines at hand will be described.

Passing now to the skull of the aged badger, it is first to be noted that the external surfaces of the cranium and mandible have a roughish feel and fine, porous appearance in some places, more particularly on the bones of the face and over the parietal region.

Viewed upon its superior aspect, the cerebral casket of the cranium is more or less globular in form, the two superficies being separated by a very prominent, mesial sagittal crest of bone, the superior rim of which is more or less thickened. The crest averages a centimeter in height for its posterior moiety, tapering away as we pass forward, to run out as raised rims limiting the temporal fossæ anteriorly (fig. 1).

Turning to the badger skull No. 2572 (fig. 2), this crest is seen to have an average height of hardly more than a millimeter; while its anterior branches, limiting the temporal fossa upon either side, are practically flush with the general surface of the cranium. In this badger, instead of being globular in form, the vault of the cranium has an outline of an isosceles triangle, its broad base being the raised rim of the occipital crest. The middle point of this crest is triangularly indented, while its lateral terminations are curved, causing their surfaces to face forwards and upwards. The extreme width at this point measures 8.2 cms. All this is entirely different in the cranium of our aged badger, wherein the occipital crest, though prominent, is low down on the cranium, circular in outline, and terminating on either side just below the osseous auricular opening. The occipital area below this crest is much limited in extent; concave supermesially, and terminating in a sharp, thin, concave edge as the superior margin of the very large foramen magnum.

In the American badger the occipital region is very extensive, being perpendicular to the longitudinal axis of the cranium, and reniform in outline—the large foramen magnum being in the center, below, and the superior elliptical curve being formed by the limiting occipital crest. These parts in the crania of the two animals present such wide differences in the matter of characters that, were there naught else to go by, the mammalogist that placed the individuals exemplifying them in different families would probably be sustained by his confrères.



SKULLS OF BADGERS

FIG. 1. Skull of a very old American Badger (*Taxidea taxus*) seen on right lateral view; mandible articulated; natural size. FIG. 2. Same view, natural size, of the skull of an adult specimen of the American Badger (*Taxidea taxus*), No. 2572, Coll. U. S. Nat. Museum.

(Shufeldt—Skull of Badger.)

Viewed upon its facial aspect, the cranium of this old badger presents the usual musteline characters of its genus. The infraorbital foramen is large and of different outline in the two skulls here being compared, as in the aged badger its outer arc is curved, to be angulated in the larger skull.

Upon anterior view, the narial aperture is always seen to be large and oval in outline in a badger, the long axis being mesial and vertical. The ethmoidal bones are extremely complicated and spongy, extending far forwards in this aged badger, and being far back in the skull here shown in figure 2. *Vomer* is to some extent incomplete.

One of the best evidences of great age in the skull here being described is the condition of its dental armature, most of the incisor teeth being lost, others broken, and the remainder all worn—worn down to an extent never before observed by me in any ferine mammal. As these teeth stand, however, it is very evident that, in the matter of the formula, they agreed originally with that of *Taxidea taxus*.

Beyond the extraordinary wearing away of the teeth, the *mandible* of our subject essentially agrees in all of its characters with what we find in the lower jaw of our common badger—the position and number of foramina having no weight. It is not permanently locked at its articulations in the glenoid fossæ. Beyond the evidences of great age, the characters seen at the *basis cranii* are typically taxidean, an apparent shrinkage of the *auditory bullæ* alone constituting any marked difference.

Washington, D. C.

BEDS OF THE GORILLA AND CHIMPANZEE

BY C. R. ASCHEMEIER

During my stay of over two years in the Gaboon District, French Congo, I was much interested in the sleeping nests or "beds" of the gorilla and the chimpanzee; and it was my good fortune to find numbers of these beds belonging to each species. Both animals, according to my observations, make their beds in as secure places as they can find, but the chimpanzee seems to favor the greatest retirement, with less chance of disturbance from its foes of the jungle. I did not see a single bed of the chimpanzee on the ground, and they were usually constructed well up in the fork or crotch of tall and quite slender trees. In no case was the nest of the chimpanzee constructed in a tree measuring over a foot and a half in diameter at the base; and the trees selected were with few branches, a good distance apart. The lowest chimpanzee bed noted was about 30 feet from the ground, and the highest (two beds here quite close together) was fully 60 feet up.

Not long after my arrival at Omboue, Fernan Vaz, from Cap Lopez, and while still a bit "green," I went into the bush a short distance, accompanied by a native boy as a guide, to look for specimens. After we had wandered about for quite a long time and had secured a few birds, my companion suddenly stopped and gazed into the upper part of a tree. I could not at first see anything and asked what was there. He replied "N'chigo anago," and as I was still new to the language I was inclined to let it go at that, but he finally managed to make me understand what he meant—a chimpanzee bed or house. He then climbed up and investigated, and when he came down I ascended. I was quite played out by the time I reached the bed, but I examined it as well as I could, with one arm free to investigate. It was in a crotch of the tree and was well made of leaves from the same tree together with what looked like parts of bushes from off the ground. From what I have learned in regard to the bed of the orang-utan, I should judge that the nests of these two apes are very similar. I wondered, and have since often been asked, if the chimpanzee uses the bed more than once. Reliable natives all agreed in saying that the same beds are never twice used.

Later on I was collecting in the bush one day when, as it was getting quite late, I decided to return to camp. I had with me at the time my most faithful and efficient guide and helper, Pambo, who suddenly stopped short in his tracks. On looking up I saw three dark forms

in a tree, and these proved to be chimpanzees preparing a bed. I was very anxious to see more of the work, but the animals unfortunately saw us and hastily started to descend. At least one of them, I was sure, was not doing any of the work and the impression I got was that it was "bossing the job." This one was the last of the three to start down the tree, and as I was able to shoot it, I found it to be a male of the type known to the natives as "koola-kamba."

The chimpanzee beds later discovered were all very much of the style of the first ones examined. The chimpanzees were usually up and about at the break of day, and were in their beds, or near them, as a rule, by sundown or shortly after.

The beds of the gorilla I found to be much more variable. Some were similar to those of the chimpanzee, but the natives always knew the difference, and if the nest had been used the night before I myself could easily tell what the occupants were. The gorilla has an odor almost as characteristic and prominent as its terrific yell. To describe this odor is quite impossible. It is pungent, and smells a bit like rubber. Often while walking along we would suddenly detect the odor of the gorilla, and on investigation find where the animals had passed or had stopped to eat.

Another style of the gorilla bed is an oblong affair on the ground, composed of bushes, grasses, and ferns. While it is not made as a man would make a similar bed, still, on seeing it, one could not say that it was not a good job. Still another type of the gorilla sleeping quarters is that where nests are made by bending and breaking saplings so that three or four will come together at the tops, thus forming a fair bed. The trees are not broken off entirely, but, about midway, just enough so they will stay down. One of the most interesting features about the beds of the gorilla is that they are made in close proximity to streams of water, where mosquitoes and insects of many kinds are particularly abundant. Perhaps the gorilla knows that other dwellers of the jungle will not stay in such places.

The natives tell me that some old male gorillas stay by themselves, and that these solitary males are the ones that use the oblong ground nests and the beds formed by the bent over saplings. The tree nests are used by the gorilla families; the old female together with the young reposes in the tree and the old male of the family sits at the base with his back leaning against it, on the lookout for his enemy the leopard. This is one of the habits that shows the great courage of the gorilla; I was told of one encounter, to the death of both, between a gorilla

and a leopard. Sometimes I saw where the male had wandered a short distance from the tree in the early morning to gather the itando plant and fruit, the hulls of which were at the base of the tree beneath the nest.

The gorilla usually left his bed shortly after daybreak in the morning; but on several occasions I surprised families, evidently "sleepy-heads," in bed an hour or two after break of day. These usually waited until we got very close to the beds and then gave out their disconcerting yells and made off. By dusk the gorillas were all in the beds.

U. S. National Museum, Washington, D. C.

DIAGNOSES OF SEVEN NEW CHIPMUNKS OF THE GENUS EUTAMIAS, WITH A LIST OF THE AMERICAN SPECIES

BY ARTHUR H. HOWELL

Recent studies of the North American chipmunks, based on the extensive series in the Biological Survey collection, supplemented by a large amount of material loaned by other museums, have revealed the existence of a number of unrecognized forms and have resulted in a much clearer conception of the relationships of the various forms.

Since publication of the complete results of these studies may necessarily be delayed for some time, it is deemed wise to publish now preliminary descriptions of the new forms and a list of the species grouped to show their relationships.

Eutamias minimus arizonensis subsp. nov.

Type.—No. 205,869, U. S. National Museum (Biological Survey collection); male adult, skin and skull; from the Prieto Plateau at the south end of Blue Range, Greenlee County, Arizona; collected September 7, 1914, by E. G. Holt; original number 384.

Subspecific characters.—Similar in size and cranial characters to *Eutamias minimus atristriatus*; nearest in color to *E. minimus consobrinus*, but general tone more grayish (less tawny), the shoulders frequently washed with pale smoke gray (as in *Eutamias cinereicollis*); tail more bushy and color of under surface brighter tawny (about as in *operarius*).

Measurements of type.—Total length, 197; tail vertebrae, 87; hind foot, 30; ear from notch, 12. *Skull*: Greatest length, 32.6; zygomatic breadth, 18; mastoid breadth, 14.5; interorbital breadth, 7.1; length of nasals, 10.1.

Remarks.—This race of the least chipmunk is restricted, so far as known, to the White Mountains and Prieto Plateau of eastern Arizona. It occurs over a

part of the range of *Eutamias cinereicollis* and so closely resembles that species in color that it has until recently escaped recognition. The sides are slightly paler and the nose less heavily washed with clay color than in *cinereicollis*, but in all other markings the resemblance between the two species is remarkable. However, *arizonensis* is decidedly smaller, with much shorter ears and hind feet, while the skull closely resembles that of *atristriatus*, and is widely different in size and proportions from that of *cinereicollis*.

***Eutamias amoenus vallicola* subsp. nov.**

Type.—No. 168,027, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Bass Creek, near Stevensville, Montana (altitude 3,725 feet); collected March 23, 1910, by Clarence Birdseye; original number 1052.

Subspecific characters.—Similar to *Eutamias amoenus luteiventris*, but averaging paler throughout, especially the head, upper parts of body, and under surface of tail.

Measurements of type.—Total length, 223; tail vertebrae, 102; hind foot, 32.5; ear from notch, 14. *Skull*: Greatest length, 33.6; zygomatic breadth, 18.8; mastoid breadth, 15; interorbital breadth, 7.5; length of nasals, 11.3.

Remarks.—This subspecies is apparently confined to the Bitterroot Valley and the adjacent foothills, but the exact limits of its range are not known. Twenty-six specimens from the valley, representing both winter and summer pelage, have been examined.

***Eutamias ruficaudus simulans* subsp. nov.**

Type.—No. ²⁸⁴⁸⁷/₄₀₅₉₁, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Cœur d'Alene, Idaho; collected June 1, 1891, by Clark P. Streater; original number 881.

Subspecific characters.—Similar to *Eutamias ruficaudus ruficaudus*, but color of sides, under surface of tail, and tail edgings paler; skull with relatively broad braincase and rostrum.

Measurements of type.—Total length, 248; tail vertebrae, 117; hind foot, 33; ear from notch, 14. *Skull*: Greatest length, 35; zygomatic breadth, 19.3; mastoid breadth, 15.8; interorbital breadth, 7.8; length of nasals, 12.1.

Remarks.—This race of the rufous-tailed chipmunk occupies the mountains of northwestern Montana (west of the main divide), northern Idaho, northeastern Washington, and southeastern British Columbia. It bears a rather striking resemblance to *Eutamias amoenus felix* of the coast region of British Columbia, but may be distinguished from that species by its slightly larger skull, longer and slightly paler tail, whiter underparts, paler sides of body and face, and more tawny head.

***Eutamias bulleri solivagus* subsp. nov.**

Type.—No. 116,882, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Sierra Guadalupe, Coahuila, Mexico; collected May 1, 1902, by E. W. Nelson and E. A. Goldman; original number 15,169.

Subspecific characters.—Similar to *Eutamias bulleri bulleri*, but sides slightly darker; head slightly paler (more grayish); tail darker beneath and edged with a darker shade of buff; hind foot shorter; skull smaller.

Measurements of type.—Total length, 234; tail vertebræ, 108; hind foot, 35; ear from notch, 17. *Skull*: Greatest length, 36.6; zygomatic breadth, 19.5; mastoidal breadth, 15.8; interorbital breadth, 8.3; length of nasals, 12.1.

Remarks.—This race apparently is confined to an isolated mountain range in southern Coahuila. It resembles typical *bulleri* in color, but is readily distinguished by the darker color of the under side of the tail. In this character it resembles *durangæ*, but differs from that race in the absence of a buffy wash on the upper parts.

Eutamias speciosus sequoiensis subsp. nov.

Type.—No. $\frac{30899}{42799}$, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from Mineral King, east fork of Kaweah River, California (altitude 7,300 feet); collected September 12, 1891, by Vernon Bailey; original number 3259.

Subspecific characters.—Similar to *Eutamias speciosus frater*, but upperparts averaging slightly darker, the median pair of dorsal stripes less whitish and more mixed with cinnamon; tail and ears averaging slightly longer; tail much darker beneath, edged with a paler shade of buff, and with a greater amount of black at the tip. Compared with *speciosus*: Upper parts more brownish and less grayish in general tone, the median pair of dorsal stripes more mixed with cinnamon; rump and hind feet more buffy (less grayish); tail decidedly longer. Compared with *callipeplus*: Upperparts and sides more extensively tawny, the median pair of dorsal stripes less whitish; shoulders darker; tail with much greater amount of black at the tip; hind feet, ears, and tail longer.

Measurements of type.—Total length, 241; tail vertebræ, 114; hind foot, 36; ear from notch, 18.1. *Skull*: Greatest length, 36.8; zygomatic breadth, 19.4; mastoidal breadth, 14.9; interorbital breadth, 8.2; length of nasals, 12.5.

Remarks.—The sequoia chipmunk ranges on the upper slopes of the southern Sierra Nevada from San Joaquin River south to Tule River and east to Mt. Whitney and Olancha Peak. Doctor Merriam referred the series from "the eastern crest of the High Sierra from Olancha Peak and Mount Whitney northward" to *speciosus*, and the series from "the western slope of the Sierra from the headwaters of Tule River northward nearly to the Yosemite Valley" to *callipeplus*.¹ With a much larger series than was then available, I can detect no constant differences between these two colonies, but as a whole they show marked differences from all the other races, as pointed out above.

Eutamias townsendii siskiyou subsp. nov.

Type.—No. 161,033, U. S. National Museum (Biological Survey collection); female adult, skin and skull; from near summit of White Mountain, Siskiyou

¹ Merriam, C. Hart, Proc. Biol. Soc. Washington, vol. 11, pp. 200, 202, 1897.

Mountains, California (altitude 6,000 feet); collected September 16, 1909, by N. Hollister; original number 3432.

Subspecific characters.—Nearest to *Eutamias townsendii senex*, from which it differs in darker coloration of the upperparts and sides, the rump and thighs especially being much more brownish (less grayish). Compared with *ochrogenys*: Coloration much more grayish (less brownish); light dorsal stripes grayish white instead of tawny-olive; sides of head and face much less ochraceous; underparts more whitish and only faintly washed with pinkish buff; tail paler beneath; skull similar to that of *ochrogenys*, but averaging smaller.

Measurements of type.—Total length, 268; tail vertebræ, 104; hind foot, 36.5; ear from notch, 15.5. *Skull*: Greatest length, 38.5; zygomatic breadth, 21.4; mastoidal breadth, 16.4; interorbital breadth, 8.2; length of nasals, 12.3.

Remarks.—The Siskiyou chipmunk occupies the Siskiyou Mountain region of northern California and southern Oregon, ranging north to the upper Rogue River Valley, Oregon. It is, of course, intermediate in characters between *senex* and *ochrogenys*, but has well defined characters distinguishing it from either and occupies an area of considerable breadth.

*Eutamias townsendii alleni*² subsp. nov.

MARIN CHIPMUNK

Tamias townsendii hindsii ALLEN, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 75, 1890, and of recent authors generally (not *Tamias hindsii* Gray).

Type specimen.—No. 135,177, U. S. Nat. Mus. (Biological Survey collection); male adult, skin and skull; from Inverness, Marin County, California; collected November 16, 1904, by N. Hollister; original number, 1378.

Geographic distribution.—Coast region of Marin County, California, from Point Reyes east to Mount Tamalpais.³

Subspecific characters.—Similar to *E. townsendii sonomæ* but slightly smaller; head and upperparts distinctly darker in both pelages; outer pair of light dorsal stripes usually strongly washed with buff; underparts averaging more buffy (less whitish); hind feet darker; tail averaging darker beneath; skull similar to that of *sonomæ* but averaging smaller. Compared with *E. townsendii ochrogenys*: Size much smaller; upperparts much brighter tawny (less olivaceous), especially in winter pelage; dorsal stripes more distinct, the dark stripes much more blackish, the light stripes more buffy; sides of face less extensively washed with ochraceous.

Measurements of type.—Total length, 231; tail vertebræ, 105; hind foot, 37; ear from notch, 16. *Skull*: Greatest length, 36.8; zygomatic breadth, 19.6; mastoidal breadth, 15.1; interorbital breadth, 7.8; length of nasals, 10.5.

Remarks.—This is a renaming of the form currently known as *Eutamias hindsii*, which name now proves to be a pure synonym of *E. townsendii townsendii*.

Inquiry of Mr. Oldfield Thomas regarding the type specimen of *Tamias hindsii* developed the fact that it is in the British Museum (No. 42.10.30.10). On the

² Named for the late Doctor J. A. Allen, the first reviser of the chipmunks of this genus.

³ Cf. Grinnell, J., Univ. Calif. Pub. Zool., vol. 12, p. 324, 1915.

assumption that this type was collected near San Francisco, California (cf. Allen, Bull. Amer. Mus. Nat. Hist., vol. 3, p. 77, 1890), specimens representing the three forms occurring in that general region—*pricei*, *sonomæ*, and "*hindsii*"—were sent to Mr. Thomas, who kindly compared them with the type of *hindsii* only to find that the latter agreed with none of them but was closely matched by specimens of *townsendii* from British Columbia.

The type specimen of *hindsii* was taken by Capt. Edward Belcher on the voyage of the *Sulphur* but the exact locality whence it came is unknown. The original label and the British Museum register credit it to "California," a name loosely applied in those days to the greater part of the Pacific coast of the United States. We learn from the narrative of the voyage of the *Sulphur* that the vessel put in at a number of ports on that coast, from Nootka Sound, British Columbia, to Magdalena Bay, Lower California and that collections were made in the vicinity of San Francisco and on the Sacramento River, also in the vicinity of Fort Vancouver, near the mouth of the Columbia River. In view of the positive identification of the type with the species inhabiting the latter region it seems most probable that the specimen was taken at or near Fort Vancouver.

Mr. Thomas's identification of the type with *Eutamias townsendii* is confirmed by an examination of the colored plate in "The Zoology of the Voyage of H. M. S. *Sulphur*," which certainly resembles *townsendii* much more nearly than it does the form from Marin County, California, which has for many years been known under the name *E. hindsii*. The original description, also, though inadequate, fits certain specimens of *townsendii* without violence and in the mention of white underparts agrees with *townsendii* rather than with the California form. Mr. Thomas is of the opinion that the inscription "near San Francisco" was written on the type label at a later date by someone in the British Museum—evidently however, without authority for the statement.

Doctor Allen in his revision of the genus in 1890, attempted to define the type locality in the following words: "*Tamias hindsii* was originally based on a specimen almost unquestionably taken in the immediate vicinity of San Francisco, California, in the month of November."⁴ That this assumption, however, is unwarranted is shown by the facts already cited.

Since *Eutamias hindsii* now becomes a synonym of *E. townsendii townsendii*, the form from Marin County, California currently known as "*hindsii*" must be provided with a new name, and it is a pleasure, therefore, to name it in honor of the late Dr. J. A. Allen.

REMARKS ON THE NOMENCLATURE OF EUTAMIAS

The last revision of the entire group was that of Allen, in 1890, in which 23 forms were recognized.⁵ Merriam, in 1897, published a synopsis of the Pacific Coast forms, with a revision of the *townsendii* and *speciosus* groups.⁶ Since the time of Allen's revision the material

⁴ Allen, J. A., Bull. Amer. Mus. Nat. Hist., vol. 3, p. 77.

⁵ Allen, J. A., op. cit., pp. 45-116, 1890.

⁶ Merriam, C. Hart, Proc. Biol. Soc. Washington, vol. 11, pp. 189-212, 1897.

available for study has vastly increased⁷ and the number of recognized forms has more than doubled; our knowledge of the distribution of the various species has of course likewise extended, but in the absence of a monograph of the group, the relationships of the species are not well understood and many forms in current nomenclature are wrongly assigned.

Much of this confusion is due to the erroneous identification by the earlier revisers of *Eutamias quadrivittatus* (the first member of the genus to be named) and their failure to recognize the distinction between the races of *Eutamias amoenus* and of *E. minimus*—two distinct species whose ranges overlap in several regions, and certain forms of which greatly resemble one another. Doctor Merriam, in 1905, showed conclusively that the name *quadrivittatus* applies to the larger of the two species occurring together in the mountains of Colorado and in the same paper named the smaller form (then currently confused with *quadrivittatus*) *E. amoenus operarius*.⁸ He did not, however, attempt a revision of these two groups, and a more detailed study of the relationships of *operarius* shows it to be a subspecies of *Eutamias minimus* rather than of *E. amoenus*.

LIST OF RECOGNIZED AMERICAN FORMS OF EUTAMIAS, WITH SYNONYMS⁹

*Eutamias alpinus*¹⁰

EUTAMIAS MINIMUS GROUP

Eutamias minimus minimus (Bachman)

Eutamias minimus pictus (Allen)

Tamias minimus melanurus Merriam

Eutamias minimus caryi Merriam

Eutamias minimus pallidus (Allen)

Eutamias minimus cacodemus Cary

Eutamias minimus consobrinus (Allen)

Eutamias lectus Allen

Eutamias consobrinus clarus Bailey

Eutamias minimus operarius Merriam

Eutamias minimus atristriatus Bailey

Eutamias minimus arizonensis, nobis

Eutamias minimus oreocetes Merriam

Eutamias minimus borealis (Allen)

⁷ Dr. Allen based his review on about 650 specimens, while the present writer has examined more than 10,000.

⁸ Merriam, C. Hart, Proc. Biol. Soc. Washington, vol. 18, pp. 163-164, 1905.

⁹ Synonyms in italics.

¹⁰ This species apparently is not closely related to any other.

Eutamias minimus caniceps Osgood
Eutamias minimus neglectus (Allen)

EUTAMIAS AMCENUS GROUP

Eutamias amoenus amoenus (Allen)
Eutamias amoenus propinquus Anthony
Eutamias amoenus monoensis Storer & Grinnell
Eutamias amoenus luteiventris (Allen)
Eutamias amoenus vallicola, nobis
Eutamias amoenus canicaudus Merriam
Eutamias amoenus affinis (Allen)
Eutamias amoenus ludibundus Hollister
Eutamias amoenus felix (Rhoads)
Eutamias amoenus caurinus Merriam
Eutamias panamintinus (Merriam)

EUTAMIAS QUADRIVITTATUS GROUP

Eutamias quadrivittatus quadrivittatus (Say)
Tamias quadrivittatus gracilis Allen
Eutamias quadrivittatus animosus Warren
Eutamias quadrivittatus hopiensis Merriam
Eutamias umbrinus (Allen)
Eutamias adsitus Allen
Eutamias ruficaudus ruficaudus Howell
Eutamias ruficaudus simulans, nobis
Eutamias cinereicollis cinereicollis (Allen)
Eutamias cinereicollis cinereus Bailey
Eutamias cinereicollis canipes Bailey
Eutamias bulleri bulleri (Allen)
Eutamias bulleri durangæ Allen
Tamias nexus Elliot
Eutamias bulleri solivagus, nobis
Eutamias speciosus speciosus (Merriam)
Eutamias speciosus callipeplus (Merriam)
Eutamias speciosus sequoiensis, nobis
Eutamias speciosus inyoensis Merriam
Eutamias speciosus frater (Allen)
Eutamias palmeri Merriam

EUTAMIAS TOWNSENDII GROUP

Eutamias townsendii townsendii (Bachman)
Tamias hindsii Gray
Tamias townsendii littoralis Elliot
Eutamias townsendii cooperi (Baird)
Eutamias townsendii ochrogenys Merriam
Eutamias townsendii siskiyau, nobis
Eutamias townsendii senex (Allen)
Eutamias townsendii sonomæ Grinnell
Eutamias townsendii alleni, nobis
Eutamias quadrimaculatus (Gray)
Tamias macrorhabdotes Merriam

Eutamias merriami merriami (Allen)
Eutamias merriami mariposæ Grinnell
Eutamias merriami pricei (Allen)
Eutamias merriami kernensis Storer & Grinnell
Eutamias merriami obscurus (Allen)
Eutamias merriami meridionalis Nelson & Goldman
Eutamias dorsalis dorsalis (Baird)
Eutamias canescens Allen
Eutamias dorsalis utahensis Merriam

Biological Survey, Washington, D. C.

GENERAL NOTES

HOARY BAT IN VERMONT

A live male specimen of the hoary bat (*Nycteris cinerea*) was picked up on the sidewalk at Woodstock, Vermont, June 20, 1921, and was presented to the writer for his private collection. This bat seems to be rare in Vermont in the breeding season although it must occur here during migrations. The only other specimen recorded as captured within the state was taken at Colchester, on Lake Champlain, October 12, 1842, and is now in the State museum at Montpelier. The writer and friends have watched for the hoary bat many evenings along mountain streams and lakes without success. On October 29, 1921, a large bat was seen flying over the marshes on a mountain lake in Wallingford, altitude 2300 feet. It was not shot as it would have been lost in the swale. The temperature had been below freezing on several occasions, and there was ice in some places when this bat was seen. The writer judged that none but a hoary bat would have showed the hardihood to be abroad at such a time.—GEORGE L. KIRK, *Rutland, Vt.*

AN INSTANCE OF UNPROVOKED ATTACK BY A BROWN BEAR

On August 25, 1921, I killed a moose while hunting on the headwaters of Sidney Creek, a tributary of the Nisutlin River, in Yukon Territory, Canada, and after butchering the same, returned to camp late in the evening.

The following morning Mr. W. E. Rumble, his son Willard Rumble and myself, taking two dogs with us, left for the scene of the kill with the intention of bringing in the meat for camp use. The moose was killed in a fairly dense thicket of willows and upon nearing the spot where the carcass was located I pushed on ahead of my companions, who were followed by the two dogs, until I was perhaps fifty or sixty feet ahead of them, entering the thicket by way of a narrow game trail. I had progressed only a short distance into the thicket when I heard a crashing in the underbrush, followed by an exclamation from one of my companions, and upon looking back, beheld a medium size brown bear charging directly toward them along the edge of the thicket. Mr. Rumble was armed with a Winchester repeating rifle, but before he could throw a load into the chamber and shoot, the dogs had rushed out at the bear and he then withheld

his fire for fear of hitting one of them. The charge of the bear had brought it to within ten feet of the Rumbles when diverted by the dogs, one of which it chased into the brush and then turned and repeated the performance with the second dog. When the bear stopped this time it was standing broadside to me just at the entrance of the game trail in which I was standing and about twenty feet distant from me. I was armed with a 7 mm. Mauser rifle and when I first saw the bear, I had, as I supposed, thrown a cartridge from the magazine into the chamber, but evidently had failed to bring the bolt back far enough to engage the shell and consequently the rifle was unloaded. Up to this point I do not think that the bear had seen me, but when my rifle snapped it turned and charged upon me, covering the intervening distance in two jumps, the first of which brought it to within six or eight feet of the spot upon which I was standing. Loading as hastily as possible, I fired and dropped to the ground, at the same time throwing up my arms to protect my face from injury. The bear had sprung at me before I fired and when I dropped, the momentum of the leap carried it clear over me, but it struck at me as I was falling and tore quite a large gash in my left forearm with one claw. By this time the dogs had recovered their morale and chased the bear into a thick clump of brush where they bayed it. My shot had evidently wounded the animal quite severely for it had spilled a large quantity of blood where it struck the ground just over my head. We immediately followed to the place where the bear had stopped and after a short time shot it in the head, but not until after it had caught one of the dogs, which had ventured too close, and given it a severe mauling. Subsequent examination showed that my first shot had penetrated the animal's heart, and although it apparently had made it quite sick, it was fully two or three minutes before it was finally dispatched by a head shot. The bear was a female weighing about six hundred pounds.

Upon going to the spot where the moose carcass had been left we discovered that the bear, after sampling each of the quarters, had dragged them together and covered the lot with dirt and moss. We returned shortly to camp, a distance of eight or nine miles, but were prevented from immediately revisiting the scene of the encounter by a spell of rainy weather that lasted five days. The bear evidently had a young one with her, for upon returning to the place after the weather had moderated, we could observe evidence that a cub had tried to suckle her.

I wish to emphasize the fact that this attack was entirely unprovoked. When the bear attacked us we were at least fifty yards from the moose carcass and, owing to the thick growth of brush intervening, were not visible from that spot. The dogs were behind Mr. Rumble and his son until the bear had almost reached them and could not possibly have provoked the attack.—A. C. BONEBRAKE, *Goldendale, Wash.*

A COYOTE IN MARYLAND

On February 5, 1921, an adult male coyote was shot 5 miles northwest of Poolesville, Montgomery County, Maryland, by Mr. John A. Jones. The animal had been seen by several people in the region at various times since early in the winter, but it had successfully evaded guns. Its chances of living were lessened,

however, when it became friendly with a female Airedale dog, lost some of its wariness, and frequently came near the farm buildings where the dog lived. It was killed with a shot gun in a field on the farm.

Mr. Jones has generously deposited the skin and skull in the Biological Survey collection, United States National Museum, where the specimen becomes number 235,503. It may be tentatively referred to *Canis latrans latrans*, but with our present confused knowledge of the taxonomic relations of the coyotes exact identification of individual specimens is almost impossible. The animal was adult, but not old, the teeth showing only a trace of wear. It differs in no pronounced color or cranial characteristics from a male specimen collected in May, 1910, at Rockford, Iowa, which may be considered typical *latrans*.

The question naturally arises as to how a coyote reached this eastern locality. It is, of course, impossible to say definitely. The animal probably escaped from captivity. Or it may represent an extreme easterly extension of the geographic range of coyotes. There is no direct evidence for or against either of the suppositions. It is known that the range of the coyote has gradually extended northward and eastward, but it would seem hardly probable that the species has, as yet, ingressed a region as far east as central Maryland.—HARTLEY H. T. JACKSON, *U. S. Biological Survey, Washington, D. C.*

AN OBSERVATION ON THE CARNIVOROUS PROPENSITIES OF THE GRAY GOPHER

While on a camping trip in northern Minnesota during August I chanced to make an interesting observation on the preying habits of the gray gopher, *Citellus franklini* (Sabine). On this particular occasion our party had stopped for lunch in a vacant yard in the forest of western Aitkin County. Suddenly we heard sharp squeals coming from the edge of a copse and looking in that direction we noticed what appeared to be a struggle going on in the grass. Hurrying to the spot we discovered a nearly full-grown gray gopher struggling with a young rabbit which it had seized behind the right ear. The gopher hesitated a moment on our approach, but did not release its grip until I stepped to within a pace of it, when it darted off a distance of two or three feet. The rabbit, I observed, was alive but unable to move. It was fully as large as the gopher. We stood still and the gopher returned to the attack, biting the rabbit furiously about the body. Again I frightened the gopher away but it returned once more to the attack and repeated its previous performance. I frightened it away a third time, but again it returned and rushed upon the prey biting it here and there about the body until it was apparently dead. Then running its nose rapidly over the carcass the gopher began gnawing at the hind quarters.

We left the scene and about twenty minutes later I returned to the spot and found the gopher still gnawing at the carcass, the hind quarters of which, except for skin and bones, had been devoured. Examining the spot where the struggle was first seen I found a small "form," in which the rabbit had apparently been lying when it was pounced upon. A week or so previous to this occasion, at Gull Lake in Crow Wing County, I watched an individual of this same species making after a striped gopher, which, however, escaped into a brush-pile.—ARTHUR M. JOHNSON, *Department of Botany, University of Minnesota.*

THE YOUNG OF THE CALIFORNIA GRAY SQUIRREL

The large arboreal nests of the California gray squirrel (*Sciurus griseus griseus* Ord) are not uncommon in the Transition Zone forests of California but the finding of young in one of these nests is a rather unusual event. In fact, I have not been able to find any published account of the young of this species except general statements relative to the number to a litter and approximate season at which they are dropped.

On April 13, 1919, while in the hills near Lake Lagunitas, Marin County, California, I examined a number of arboreal nests of mammals. Some of these were the work of the brown-footed woodrat, but the majority of those investigated had been made by gray squirrels as attested by their smaller and more rounded form, more compact structure, and greater height above the ground. In the Sierra Nevada nests of the gray squirrel are more often placed in conifers, but in the coast redwood belt the animals use the live oak, California laurel, and madrone. The nest discussed here was about 40 feet above the ground in a live oak, just within the crown of green leaves at the top of the tree. It came to attention only when the tree was examined from directly beneath. The nest tree was in a grove of live oaks on a slight rise of ground between two rather level small valleys.

This nest was about 50 centimeters in outside diameter. The form of the base of the nest suggested that it might originally have been constructed by a western crow, a bird which is common in many parts of Marin County. There were portions of several flight feathers of a crow in the nest but these could well have been picked up on the ground by the parent squirrel when gathering material for the nest lining. The central soft portion of the nest was about 25 centimeters in diameter. At the bottom it was made up of shredded oak bark prepared by the parent squirrel in the manner common to many rodents, and much of this material was in very short lengths. Above this was a soft mass of gray lichen, chiefly *Usnea florida* but with some *Evernia prunastri* and a slight amount of a moss, *Alsia longipes*. Over the moss and lichen were some live oak twigs cut green to which the leaves were still adhering. In the central soft part of the nest were the two young squirrels where they could easily keep warm while the female was away.

The young squirrels were packed in an "egg" box and taken to Berkeley where they were kept alive for a few days, being sheltered in a box lined with cotton. They were fed on "Carnation" condensed milk, diluted with three parts of water. This diet was obviously unsuitable as it caused a violent digestive disturbance, more or less constipation, followed by a profuse diarrhea, and so weakened the young that they had to be killed and preserved as specimens. Upon autopsy of one of the squirrels the caecum was found to contain much caseated milk and to be bloated with gas. Possibly cow's milk would have been more suitable. Instances have been reported where a cat whose young have been removed has acted as foster parent for young squirrels. Great difficulty was experienced in keeping the young squirrels sufficiently warm.

When the nest was first opened a finger thrust at the young squirrels was eagerly seized and sucked—an obvious feeding reflex. Later, in captivity, whenever they were touched, their forefeet would work around and eagerly

grasp a person's hand. On the evening of capture, warm diluted "Carnation" milk was offered in a glass medicine dropper. Little was taken then, but the next day they fed five times, and at one feeding each took about 10 cubic centimeters of the milk. The following day they were fed four times at intervals of approximately four hours, taking about the same amount at each feeding. Similar feeding was carried on for two days more but by the fifth day they showed little desire to feed, and their weakened condition caused abandonment of further attempts to keep them alive. Often a finger wet with milk would be seized and sucked on eagerly until all the milk had been drawn in. The tongue was held in a broad U-shape when sucking.

When feeding, the young pushed outwardly with their fore feet, and they suckled the medicine dropper contentedly only when their feet found a surface against which they could press. Presumably when feeding normally they massage the mammary glands of the female as do the young of domesticated animals. They squirmed a good deal while feeding but more than once upon having their hunger satisfied they fell asleep before being put away. Between feedings the young spent practically all of their time asleep. When first taken they twitched and twisted while asleep but this was less evident as they grew larger. When asleep they curled up with the nose toward the lower part of the abdomen and often with one hind leg thrown over the head. The young uttered low squealing sounds when taken from the nest and later, in captivity, especially if they became cold.

When first seen the skin of the young squirrels was loose and wrinkled. Three days afterward their bodies had filled out so that this condition had entirely disappeared. The hair, which at first was but a slight growth on the dorsal surface, had in the same period of time grown rapidly, and the white lateral fringing of the tail began to show. A brown spot appeared at the inner base of each ear and the black ended overhairs on the dorsum showed conspicuously. But there was only a very slight growth of hair on the belly during this time. The whole appearance of the young was substantially changed during this interval. When found, the disproportionate size of the head and feet suggested the young of a carnivorous mammal. This changed to a typical squirrel appearance within three days.

At no time were the eyes open, although to judge from their growth in captivity the squirrels must have been more than a week old when found. Forty-eight hours after being collected the male weighed 74.6 grams and measured (approximately) $205 \times 93 \times 34 \times 8$ millimeters. Three days later he measured $220 \times 100 \times 35 \times 8$. The female weighed and measured at the same time, was 80.4 grams and measured $225 \times 95 \times 37 \times 8$. Similarly, when prepared as a specimen, she measured $240 \times 102 \times 40 \times -$. Weights were not taken subsequently as the animals were much reduced by their enteritis and weights then would not have been significant.—TRACY I. STORER, *Museum of Vertebrate Zoology, University of California, Berkeley, Calif.*

RECENT LITERATURE

Hornaday, William T. *THE MINDS AND MANNERS OF WILD ANIMALS. A BOOK OF PERSONAL OBSERVATIONS.* New York: Charles Scribner's Sons. Pp. i-x, 1-328, illust. \$2.50. May, 1922.

The *Minds and Manners of Wild Animals* is "a book of personal observations" by one who has given sixty years to the sympathetic study of the creatures about which he writes. The result is a remarkably interesting description of the behavior of a wide variety of vertebrates under various conditions in nature or in captivity. Quotations are notably few in number. The author well proves the truth of his assertion that "To the inquirer who enters the field of animal thought with an open mind, and free from the trammels of egotism and fear regarding man's place in nature, this study will prove an endless succession of surprises and delights." Every page bears witness to this fact. Doctor Hornaday has not allowed his interest and enthusiasm to run away with his common sense and good judgment. He keeps in mind his own dictum that "In studying the wild-animal mind, the boundary line between Reality and Dreamland is mighty easy to cross. He who yields to seductive reasoning, and the call of the wild imagination, soon will become a dreamer of dreams and a seer of visions of things that never occurred. The temptation to place upon simple acts of animals the most complex and far-fetched interpretations is a trap ever ready for the feet of the unwary. It is better to see nothing than to see a lot of things that are not true." . . . "The student must not deceive himself by overestimating mental values. If an estimate must be made, make it under the mark of truth rather than above it. While avoiding the folly of idealism, we also must shun the ways of the narrow mind, and the eyes that refuse to see the truth. Wild animals are not superhuman demigods of wisdom; but neither are they idiots, unable to reason from cause to effect along the simple lines that vitally affect their existence." . . . "Brain-owning wild animals are not mere machines of flesh and blood, set a-going by the accident of birth, and running for life on the narrow-gauge railway of Heredity. . . . Some animals have more intelligence than some men; and some have far better morals."

The long-debated question of the reasoning power of animals is answered by Hornaday in a very positive manner. He says: "Yes. Animals do reason. If any one truth has come out of all the critical or uncritical study of the animal mind that has been going on for two centuries, it is this. Animals do reason; they have always reasoned, and as long as animals live they never will cease to reason." And again, "The wild animal must think, or die."

The book as a whole is divided into four sections. First, there is "A Survey of the Field" in which, following certain introductory statements and generalizations, there is a discussion of the temperament and individuality of wild animals, in which temperament is subdivided into six types, "the morose, lymphatic, sanguine, nervous, hysterical, and combative," and a comparatively long list of the larger mammals is given under these heads. The language of animals is discussed in a chapter which covers a range from frogs to primates. As language, the author considers four sorts, vocal, pictured, written, and sign. "The higher wild animals express their thoughts and feelings usually by sign language, and rarely by vocal sounds. Their power of expression varies species by species, or

tribe by tribe, quite as it does among the races and tribes of men." In his discussion of "The Most Intelligent Animals," Hornaday concludes that "the Chimpanzee is the most intelligent of all animals below man," though his account of the famous gorilla, John Daniel, leaves the reviewer in doubt as to whether, at least in that individual case, the palm should not have been awarded to the gorilla. The orang is put second and the elephant third. The remarkable manifestations of intelligence in the horse and dog are ascribed to their long association with man. "The Beaver manifests, in domestic economy, more intelligence, mechanical skill, and reasoning power than any other wild animal."

The chapter on "The Rights of Wild Animals" sounds the note so often and so forcibly presented in the previous works of the author. He pleads that "toward wild life, our highest duty is to be sane and sensible, in order to be just, and to promote the greatest good for the greatest number." The chapter concludes with twenty-six articles of "The Wild Animals' Bill of Rights."

The second section of the book is entitled "Mental Traits of Wild Animals," and includes discussions of "The Brightest Minds among American Animals," wherein "the prize for greatest cunning and foresight in self-preservation" is awarded to the common brown rat. "The championship for keen strategy in self-preservation belongs to the musk-oxen for their wolf-proof circle of heads and horns." The wolverine is considered to display the greatest cunning, with the gray wolf and the grizzly bear not far behind. "Among the hoofed and horned animals of North America the white-tailed deer is the shrewdest in the recognition of its enemies, the wisest in the choice of cover, and in measures for self-preservation."

"Keen Birds and Dull Men" is an interesting comparison of the brightest of the feathered tribes with three of the lowest tribes of mankind. The conclusion is reached that "the highest animals intellectually are higher than the lowest men." . . . "If the whole truth could be known, I believe it would be found that the stock of ideas possessed and used by the groups of highly-endowed birds would fully equal the ideas of such tribes of simple-minded men as those mentioned." The chapters on the mental status of the orang-utan, chimpanzee, gorilla, and elephant are among the most valuable and interesting of the book. Space forbids a detailed account of their contents, and in fact they must be read in their entirety to be fully appreciated. The reader will emerge quite in sympathy with the conclusion that "the study of this ape's mind (Peter, a chimpanzee) is a subject fit, not for the animal psychologist, but for the child psychologist." "The Wisdom of the Serpent" is a chapter to be most highly commended. Certain aphorisms are worthy of quotation. "A fool and his snake are soon parted." "If your police record is clear, you can sleep safely in the sage-brush." "The largest snakes of the world exist only in the human mind." "Men do far more fighting per capita than any snakes yet discovered."

By no means the least valuable chapter is that on "The Training of Wild Animals." "It is incontestably true that dull and stupid animals can learn little, and perform less. . . . Really, the brain, the memory and reason must enter into every animal performance that amounts to anything worth while."

The author's point of view in the last two sections on the higher and lower passions of wild animals is set forth in such words as these, "Wild animals *have*

moral codes, and on the average they live up to them better than men do to theirs." "The crimes of captive animals are many, but the crimes of free wild animals are comparatively few." In his discussion of the play of animals Hornaday expresses a commendable wish when he says, "Very sincerely do we wish that at least one of the many romance writers who are so industriously inventing wild-animal blood-and-thunder stories would do more work with his eyes and less with his imagination."

The concluding paragraphs of this interesting and stimulating volume are worth quoting as the mature conclusions of one who knows wild animals with an intimacy possessed by few other men living or dead. He says:

"On one side of the heights above the River of Life stand the men of this little world,—the fully developed, the underdone, and the unbaked, in one struggling seething mass. On the other side, and on a level but one step lower down, stands the vanguard of the long procession of 'Lower' Animals, led by the chimpanzee, the orang and the gorilla. The natural bridge that *almost* spans the chasm lacks only the keystone of the arch. Give the apes just one thing—speech,—and the bridge is closed!

"Take away from a child its sight, speech and hearing, and the whole world is a mystery, which only the hardest toil of science and education ever can reveal. Give back hearing and sight, without speech, and even then the world is only half available. Give a chimpanzee articulate expression and language, and no one could fix a limit to his progress. Take away from a man the use of one lobe of his brain, and he is rendered speechless.

"The great Apes have travelled up the River of Life on the opposite side from Man, but they are only one lap behind him. Let us not deceive ourselves about that. Remember that truth is inexorable in its demand to be heard.

"We need not rack our poor, finite minds over the final problem of evolution, or the final destiny of Man and Ape. We cannot prove anything beyond what we see. We do not know, and we never can know, whether the chimpanzee has a 'soul' or not; and we cannot *prove* that the soul of man is immortal. If man possesses a soul of lofty stature, why not a soul of lowly stature for the chimpanzee? We do not know just *where* 'heaven' is; and we cannot know until we find it. But what does it all matter on earth, if we keep to the straight path, and rest our faith upon the Great Unseen Power that we call God? Said the great Poet of Nature in his ode 'To a Waterfowl,'

" 'He who from zone to zone

Guides through the boundless sky thy certain flight,

In the long way that I must tread alone

Will lead my steps aright.' "

This is a work that will be received with approval neither by the "behaviorists" who insist that to know an animal's mind it must be subjected to laboratory tests utterly foreign to its usual life-experiences, nor by the orthodox psychologist who looks upon the human mind as differing in kind from that of lower forms. But to the lover of wild animals in their native haunts it has an appeal that defies over-statement. It is a continuous invitation to come out into the wilds and see for one's self. Doctor Hornaday is to be thanked for having given to naturalists such an interesting and trustworthy account of the results of his many years of association with the life of animals.

—H. H. Lane.

Webster, E. B. THE KING OF THE OLYMPICS. THE ROOSEVELT ELK AND OTHER MAMMALS OF THE OLYMPIC MOUNTAINS. Port Angeles, Washington; the Port Angeles Evening News. 8vo, 227 pp., numerous unnumbered half-tones. 1920.

Significant of the increasing interest in the out-of-doors in the Pacific Northwest is the appearance of this attractive volume by E. B. Webster, moving spirit and leader of the Klahhane mountaineering club of Port Angeles, Washington, and member also of the Pacific Northwest Bird and Mammal Club and the American Society of Mammalogists. It is written, not from the standpoint of sportsman or technical mammalogist, but from that of a mountaineer and friend of wild life.

The King of the Olympics is, of course, the Roosevelt elk, *Cervus roosevelti* Merriam or *Cervus canadensis occidentalis* Hamilton Smith, and the longest and most important chapter of the book is very properly devoted to a study of this magnificent animal in its principal habitat. The author has made a valuable contribution to knowledge of the habits and relations to environment of the elk, including its protective coloration, trails, present and former distribution in the Olympic Mountains, food, herding and breeding habits, fighting, young, and enemies. Many of the data were gathered by Mr. Webster himself in course of frequent trips to the mountains; and, in addition, the observations of William Everett, Chris Morganroth, George Welch, and Grant Humes, mountain men of wide experience in the Olympic region, have been freely drawn upon.

It was found that the lives of the wolf, cougar, bear, and deer were so closely linked with that of the elk that accounts of their habits seemed necessary to complete the story of the elk. "This done it was but a step to the remaining mammals of the Olympics—some thirty odd chapters in all." Among these accounts, those of the cougar, marmot, timber wolf, chehalis (mountain beaver), and black bear are of special value.

The book is illustrated with numerous half-tones, including several of the elk in its normal environment. The typography is clear, the paper of excellent quality, and the binding plain but durable. An index would have made the volume somewhat more useful. The few scientific names included could have been made more acceptable if they had been edited by a technical mammalogist.

The author's style is informal and attractive, and an occasional story enlivens the text. The reader has no difficulty, however, in separating the "stories" from the serious observations of fact, which is more than can be said for some writings on natural history.

We wish the author had given us his opinion of what to do to insure the conservation of the elk, a matter which has been much discussed by protectionists, few of whom have had his extended opportunities for first-hand contact with the problem.

The book should help to stimulate popular interest in mammals, which deserve far more attention from conscientious writers on nature than they have received hitherto. It will be a welcome addition to any library pertaining to the woods, fields, and mountains, and their animal denizens.

—Walter P. Taylor.

- ADAMS, CHARLES C. Suggestions for research on North American big game and fur-bearing animals. *Roosevelt Wild Life Bull.*, vol. 1, no. 1, pp. 35-41. December, 1921.
- AHRENS, THEODOR G. Aims and status of plant and animal preserve work in Europe, with special reference to Germany, including a list of the most important publications on these preserves. *Roosevelt Wild Life Bull.*, vol. 1, no. 1, pp. 83-94. December, 1921.
- ALLEN, GLOVER M. Bats from Palawan, Philippine Islands. *Occ. Pap. Mus. Zool., Univ. Michigan*, no. 110, pp. 1-5. February 25, 1922. (Seven species; *Rhinolophus anderseni aequalis* is new.)
- ANDREWS, C. W. Note on the skull of *Dinotherium giganteum* in the British Museum. *Proc. Zool. Soc. London*, 1921, pt. 3, pp. 525-534. September, 1921.
- ANTHONY, H. E. Preliminary report on Ecuadorean mammals. No. 2. *Amer. Mus. Novit.*, no. 32, pp. 1-6; map. March 4, 1922. (New species of *Phyllotis*, *Microsciurus*, and *Marmosa*.)
- A new fossil rodent from Ecuador. *Amer. Mus. Novit.*, no. 35, pp. 1-4; 2 figs. March 30, 1922. (Describes *Drytomomys aequatorialis*, gen. et spec. nov.)
- BAILEY, VERNON. The flag squirrel. *Native Life (Bismarck, N. D.)*, vol. 2, no. 1, pp. 7-8. March, 1922. (Brief popular notes on habits of *Citellus tridecemlineatus*.)
- BARBER, W. E. Deer still plentiful in Wisconsin. *Wisconsin Conservationist*, vol. 3, no. 6, p. 16. January (March), 1922. (Reports 4005 bucks killed in Wisconsin during open season of 1921, with probably an additional 500 to 1000 which were not reported.)
- Again, our fur-bearing animals. *Wisconsin Conservationist*, vol. 4, no. 1, p. 11. March (May 11), 1922. (All fur-bearing animals in Wisconsin, excepting perhaps the skunk, are reduced to danger line. Beavers were unmercifully slaughtered during the past season.)
- BARNES, CLAUDE T. Mammals of Utah. *Bull. Univ. Utah*, vol. 12, no. 15; 176 pp., 32 maps. April, 1922. (A list of the mammals known from Utah, with maps showing their distribution in the state.)
- BEAKBANE, A. B. The case against the beaver. *Forest and Stream*, vol. 92, no. 5, pp. 203, 236, 239-240. May, 1922. (Claims that beavers are fast destroying trout streams in the Adirondacks.)
- BRINKMANN, AUGUST. Canidenstudien. *Vidensk. Meddel. fra Dansk naturhist. Foren. Kjøbenhavn*, vol. 72, pp. 1-43; pls. 1-3; text figs. 1-6. 1921. (*Canis pallipes* is distinct from *C. lupus* and is the original of the large domestic greyhounds.)
- CADWALADER, WILLIAMS B. The fiftieth annual report of the board of directors of the Zoological Society of Philadelphia. Pp. 52. 1922.
- CASTLE, W. E. Genetics of the Vienna white rabbit. *Science*, n.s., vol. 55, pp. 269-270. March 10, 1922.
- CLARK, D. H. Against the buck law. *Wisconsin Conservationist*, vol. 3, no. 6, p. 11. January (March), 1922. (Opposes "one buck law.")
- COLE, H. E. Wild life in Baraboo Hills. *Wisconsin Conservationist*, vol. 3, no. 6, p. 9. January (March), 1922. (Largely an account of a raccoon farm and raccoon habits.)

- COLEMAN, LAURENCE VAIL. Some principles of group construction. Museum Work, vol. 3, pp. 121-125. January, 1921. (Particular reference to museum groups of mammals.)
- COOPER, C. FORSTER. *Metamynodon bugtiensis*, sp. n., from the Dera Bugti deposits of Baluchistan.—Preliminary notice. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 617-620; 2 figs. May, 1922.
- DICE, LEE RAYMOND. Some factors affecting the distribution of the prairie vole, forest deer mouse, and prairie deer mouse. Ecology, vol. 3, pp. 29-47. January (March), 1922.
- DICE, L. R., AND H. B. SHERMAN. Notes on the mammals of Gogebic and Ontonagon Counties, Michigan, 1920. Occ. Pap. Mus. Zool., Univ. Michigan, no. 109, pp. 1-46; 3 plates. February 25, 1922. (Lists 42 species.)
- DOLLMAN, J. G. Catalogue of the Selous collection of big game in the British Museum (Natural History). London: British Museum; pp. i-vii; 1-112; portrait. 1921.
- ÉHİK, J. The glacial-theories in the light of biological investigation. Ann. Mus. Hung., Budapest, vol. 18, pp. 89-110; 7 figs. 1921.
- FRICK, CHILDS. Extinct vertebrate faunas of the badlands of Bautista Creek and San Timoteo Cañon, southern California. Univ. California Pub. Geol., vol. 12, no. 5, pp. 277-424; pls. 43-50; 165 figs. in text. December 28, 1921. (New species of *Equus*, *Pliohippus*, *Tapirus*, *Pliauchenia*, *Procamelus*, *Prosthennops*, *Hypolagus*, and *Hyaenarctos*.)
- GARLAND, H. P. The water buffalo (often called the mud buffalo) its characteristics and habits together with a description of the preparation of its hide for making loom pickers. Pp. 1-51; 38 figs. Garland Manufacturing Co., Saco, Maine. Smith and Porter press, Boston. 1922. (A most attractive book on the water buffalo and its economic uses.)
- HALL, FRANK GREGORY. The vital limit of exsiccation of certain animals. Biol. Bull., vol. 42, pp. 31-51. January, 1922. (Includes *Peromyscus leucopus noveboracensis*, *Microtus pennsylvanicus*, and *Mus musculus* among the animals used in experiments.)
- HANNA, G. DALLAS. What becomes of the fur seals. Science, n.s., vol. 55, pp. 505-507. May 12, 1922. (Suggests an investigation of the activities of the killer whale.)
- HARMER, S. F. Report on Cetacea stranded on the British coasts during 1919 and 1920. British Museum, no. 7, pp. 1-18; map. February 26, 1921.
- HAY, OLIVER P. Occurrence of Scott's gray fox in probably recent cave deposits in Kentucky. Proc. Biol. Soc. Washington, vol. 35, pp. 53-54. March 20, 1922.
- HINTON, M. A. C., AND R. C. WROUGHTON. The synonymies, characters and distribution of the macaques included under the names *rhesus* and *assamensis* in Blanford's Mammals. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 665-672. 1921. (The name of the common rhesus monkey becomes *Macaca mulatta*.)
- On the nomenclature of the South Indian long-tailed macaques. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 813-815. 1921.
- HORNADAY, WILLIAM T. Will our vanishing game be saved. Wisconsin Conservationist, vol. 3, no. 6, p. 7. January (March), 1922.

- HOWE, INEZ ADDIE. Habitat groups at the Fairbanks Museum. Museum Work, vol. 3, pp. 125-127. January, 1921. (Describes in some detail muskrat group in Fairbanks Museum, St. Johnsbury, Vermont, and mentions groups of opossum, woodchuck, bison, and moose.)
- JACKSON, HARTLEY H. T. New species and subspecies of *Sorex* from western America. Journ. Washington Acad. Sci., vol. 12, no. 11, pp. 262-264. June 4, 1922. (New forms described from British Columbia, Oregon, and California.)
- JENNESS, D. The life of the Copper Eskimos. Rep. Canadian Arctic Exped. 1913-18, vol. 12, pp. 1-277, 9 plates, 69 figs., 2 maps. Ottawa, 1922. (Contains numerous valuable notes on Arctic mammals.)
- JONES, F. WOOD. The external characters of pouch embryos of marsupials. No. 2.—*Notoryctes typhlops*. Trans. Roy. Soc. South Australia, vol. 14, 1921.
- The status of the dingo. Trans. Roy. Soc. South Australia, vol. 14, pp. 254-263. 1921. (Believes that the dingo is simply a subspecies of *Canis familiaris* introduced into Australia by man.)
- KELLOGG, REMINGTON. Change of name. Proc. Biol. Soc. Washington, vol. 35, p. 78. March 20, 1922. (*Microtus californicus neglectus* Kellogg becomes *M. c. sanctidiegi*.)
- Pinnipeds from Miocene and Pleistocene deposits of California. A description of a new genus and species of sea lion from the Temblor together with seal remains from the Santa Margarita and San Pedro formations and a résumé of current theories regarding origin of Pinnipedia. Univ. Calif. Pub. Dept. Geol. Sci., vol. 13, pp. 23-132, 6 figs. April 14, 1922.
- A study of the Californian forms of the *Microtus montanus* group of meadow mice. Univ. Calif. Pub. Zool., vol. 21, no. 7, pp. 245-274; 25 figs. April 18, 1922.
- A synopsis of the *Microtus mordax* group of meadow mice in California. Univ. Calif. Pub. Zool., vol. 21, no. 8, pp. 275-302; 1 plate; 29 figs. April 18, 1922. (New subspecies: *Microtus mordax sierrae*, Yosemite National Park.)
- KINGSLEY, A. W. Another opponent. Wisconsin Conservationist, vol. 3, no. 6, p. 11. January (March), 1922. (Opposes the "one buck law" for deer.)
- KLATT, BERTHOLD. Mendelismus Domestikation und Kraniologie. Archiv für Anthropologie, Neue Folge, vol. 18, pp. 225-250; 4 figs. 1921. (Repeats the error of comparing the skull of the ferret, *Putorius* near *eversmanni*, with that of the polecat, *P. putorius*, and attributing the differences in form to changed habits under domestication.)
- LAWSON, PUBLIUS V. Thure Kumlien. Trans. Wisconsin Acad. Sci., Arts and Letters, vol. 20, pp. 663-686; pls. 62-64. March, 1922. (Account of the life of the naturalist Thure Kumlien.)
- LONGMAN, HEBER A. A Queensland rabbit-bandicoot. Queensland Nat., vol. 3, no. 3, pp. 52-53. February, 1922.
- LÖNNBERG, EINAR. A third contribution to the mammalogy of Ecuador. Archiv für Zoologi, vol. 14, no. 20, pp. 1-23; 3 figs. 1922. (New: *Callicebus cupreus napoleon*, Napo River; *Odocoileus peruvianus consul*, Guamani; and *Choloepus napensis*, Napo River.)

- LÖNNBERG, EINAR. Some remarks about eastern hedgehogs. *Ann. and Mag. Nat. Hist.*, ser. 9, vol. 9, pp. 620-629. May, 1922. (Describes *Erinaceus koreanus*, sp. nov.)
- LOVERIDGE, ARTHUR. Notes on East African Mammalia (other than horned ungulates) collected or kept in captivity 1915-1919. Part II. *Journ. East Africa and Uganda Nat. Hist. Soc.*, no. 17, pp. 39-69. March, 1922.
- MARCHAL, PAUL. Destruction des campagnols. *Comptes Rendus Séances Acad. Agric. France*, vol. 8, pp. 130-131. February, 1922. (Successful use of a modified Danyze virus in destroying field mice in departments of Marne, Meuse, and Ardennes, France.)
- MARTINO, V. AND E. Note on a new snow-vole from Montenegro [*Microtus (Chionomys) bogdanovi*, sp. n.]. *Ann. and Mag. Nat. Hist.*, ser. 9, vol. 9, p. 413. April, 1922.
- MATSUMOTO, H. *Megalohyrax* Andrews and *Titanohyrax*, g.n.—A revision of the genera of hyracoids from the Fayûm, Egypt. *Proc. Zool. Soc. London*, 1921, pt. 4, pp. 839-850. January, 1922.
- MATTHEW, W. D. Urus and bison. *Nat. Hist.*, vol. 21, pp. 598-606; 4 figs. November-December, 1921.
- Why palæontology? *Nat. Hist.*, vol. 21, pp. 639-641. November-December, 1921.
- MCNAUGHTON, JAMES W. A stray moose. *Wisconsin Conservationist*, vol. 3, no. 6, p. 12. January (March), 1922. (Moose lassoed September 11, 1921, in Allouez Bay, Lake Superior, while swimming toward Wisconsin shore.)
- NELSON, E. W. Decrease of fur-bearing animals in Alaska. *Nat. Hist.*, vol. 22, p. 83. January-February, 1922.
- ORTLEPP, M. A. A new trichostongyle genus from an armadillo, *Euphrectus villosus*. *Ann. and Mag. Nat. Hist.*, ser. 9, vol. 9, pp. 413-421. April, 1922.
- OSBORN, HENRY FAIRFIELD. The dawn man of Piltdown, Sussex. *Nat. Hist.*, vol. 21, pp. 577-590; 15 figs. November-December, 1921. (The Piltdown jaw is human, not chimpanzee, and belongs with the skull of *Eoanthropus*.)
- *Hesperopithecus*, the first anthropoid primate found in America. *Science*, n.s., vol. 55, pp. 463-465. May 5, 1922. (Describes *Hesperopithecus haroldcookii* from Agate, Nebraska; Pliocene.)
- PALMER, T. S. Game as a national resource. *U. S. Dept. Agric., Bull.* 1049, pp. 1-48. March 14, 1922. (Contains much information on big game.)
- POCOCK, R. I. The auditory bulla and other cranial characters in the Mustelidæ. *Proc. Zool. Soc. London*, 1921, pt. 3, pp. 473-486. September, 1921.
- On the external characters of some species of Lutriniæ (otters). *Proc. Zool. Soc. London*, 1921, pt. 3, pp. 535-546. September, 1921.
- SCHEFFER, THEO. H. American moles as agricultural pests and as fur producers. *U. S. Dept. Agric., Farm. Bull.* 1247. 23 pp., 16 figs. March, 1922.
- SCHWARZ, ERNST. Huftiere aus West- und Zentralafrika. *Ergebnisse der Zweiten Deutschen Zentral-Afrika-Exped. 1910-11*, vol. 1, Zoologie, pp. 831-1044; pls. 33-48. June, 1920.
- Fledermäuse aus West- und Zentralafrika. *Ergebnisse der Zweiten Deutschen Zentral-Afrika-Exped. 1910-11*, vol. 1, Zoologie, pp. 1045-1062. June, 1920.

- SCHWARZ, ERNST. Nagetiere aus West- und Zentral-Afrika. Ergebnisse der Zweiten Deutschen Zentral-Afrika-Exped. 1910-11, vol. 1, Zoologie, pp. 1063-1090. June, 1920.
- SHUFELDT, R. W. The exhibition series of birds and mammals in the United States National Museum. Museum Work, vol. 3, pp. 178-185. March, 1921.
- SONNTAG, CHARLES F. The comparative anatomy of the tongues of the Mammalia. IV. Families 3 and 4. Cebidæ and Hapalidæ. Proc. Zool. Soc. London, 1921, pt. 3, pp. 497-524. September, 1921.
- The comparative anatomy of the koala (*Phascogale cinereus*) and the vulpine phalanger (*Trichosurus vulpecula*). Proc. Zool. Soc. London, 1921, pt. 3, pp. 547-577; pls. 5-6. September, 1921.
- On some abnormalities in the Carnivora. Proc. Zool. Soc. London, 1921, pt. 3, pp. 587-590. September, 1921.
- The comparative anatomy of the tongues of the Mammalia. V. Lemuroidea and Tarsiodea. Proc. Zool. Soc. London, 1921, pt. 4, pp. 741-755. January, 1922.
- The comparative anatomy of the tongues of the Mammalia. VI. Summary and classification of the tongues of the Primates. Proc. Zool. Soc. London, 1921, pt. 4, pp. 757-767. January, 1922.
- Contributions to the visceral anatomy and myology of the Marsupialia. Proc. Zool. Soc. London, 1921, pt. 4, pp. 851-882. January, 1922.
- SOPER, J. DEWEY. Gleanings from the Canadian West. Part II. Mammalian fauna of Islay, Alberta. Canadian Field-Nat., vol. 35, pp. 102-111. (September, 1921) February 3, 1922.
- STUCK, HUDSON. Some game trails of Alaska. Country Life, vol. 40, no. 3, pp. 35-39; 3 col. pls. and 6 figs. July, 1921.
- THOMAS, OLDFIELD. On a collection of rats and shrews from the Dutch East Indian Islands. Treubia, vol. 2, livr. 1, pp. 109-114. 1921.
- Scientific results from the Mammal Survey. XXVII. The geographical races of *Scotomanes ornatus*. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 772-773. 1921.
- A subdivision of the genus *Uromys*. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 260-261. March, 1922. (New genus, *Melomys*, for *Uromys rufescens* and allied forms.)
- New mammals from New Guinea and neighboring islands. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 261-265. March, 1922.
- A new marmoset from the Lower Amazons. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 265-266. March, 1922. (Describes *Mystax ursulus umbratus*.)
- The generic classification of the *Taphozous* group. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 266-267. March, 1922. (New genus: *Liponycteris*.)
- The forms of *Jaculus jaculus* in Egypt and Syria. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 295-297. April, 1922.
- Two new jerboa-rats (*Notomys*). Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 315-317. April, 1922.
- On the animals known as "ground-hogs" or "cane-rats" in Africa. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 389-392. April, 1922. (De-

- scribes new subspecies of *Thryonomys swinderianus*; and a new genus, *Cheromys*, for *T. gregorianus* and its allies.)
- TOWERRE, R. W. A whaling trip. Wisconsin Conservationist, vol. 4, no. 1, pp. 8, 10. March (May 11), 1922.
- TROXELL, EDWARD L. Oligocene rodents of the genus *Ischyromys*. Amer. Journ. Sci., ser. 5, vol. 3, pp. 123-130; 7 figs. February, 1922. (New species from Middle Oligocene, Cherry Creek, Colorado, and from Lower Oreodon beds near Harrison, Nebraska.)
- TUBANGUI, MARCOS A. Two new intestinal trematodes from the dog in China. Proc. U. S. Nat. Mus., vol. 60, art. 20, pp. 1-12, 4 pls. May, 1922.
- WALLACE, A. F. Timber wolf. Wisconsin Conservationist, vol. 3, no. 6, p. 11. January (March), 1922. (Methods of trapping.)
- WHITMAN, ROGER B. Hunting with brush and gun. Country Life, vol. 40, no. 5, pp. 34-39; 5 half-tones and 4 colored plates. September, 1921. (Paintings and sketches of big game by Carl Rungius.)
- WROUGHTON, R. C. On the *erythraeus* group of squirrels. Journ. Bombay Nat. Hist. Soc., vol. 27, pp. 773-777. 1921.

FOURTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The fourth annual meeting of the American Society of Mammalogists was held in the American Museum of Natural History, New York City, May 16-18, 1922. There were 52 members in attendance. One of the more important items of business transacted was the hearty endorsement of the raising of a publication fund in honor of the late Dr. J. A. Allen. This fund is to be known as the Allen Memorial Fund and is to be administered by the directors of the Society. It is planned to raise not less than \$10,000, the income of which shall be used for the publication of certain numbers of the Journal of Mammalogy to be dedicated to the memory of Doctor Allen. Thus in creating this fund we shall not only honor this eminent and pioneer mammalogist, our first honorary member, and a man beloved by all who knew him, but we shall also make possible the publication of a number of the Journal about once every year from the proceeds of the fund. This should enable us to increase the pagination of each number of the Journal to at least 100 pages. Each member of the Society will be given an opportunity to contribute to the memorium. Let us make an actual sacrifice for this cause, realizing that by so doing we shall not only continually bring to life the memory of Doctor Allen, but shall enhance our more selfish interests by improving the Journal of Mammalogy. The Allen Memorial committee appointed by the president consists of Mr. Madison Grant, chairman; Dr. Henry Fairfield Osborn; Mr. Childs Frick; Dr. George Bird Grinnell, and Mr. H. E. Anthony. Local committees to act with the central committee may be appointed later.

The Directors of the Society sanctioned the organization of the Southern California Section of the American Society of Mammalogists, of which Mr. A. B. Howell has been elected president, and Mr. Luther Little secretary.

The competitive exhibition of photographs of mammals, installed by the American Museum of Natural History in connection with the meeting, was a

noteworthy success. Nearly 1700 photographs from about 140 persons were exhibited. The judges appointed by the Society were Dr. Wilfred H. Osgood, chairman; Mr. H. E. Anthony; Dr. Witmer Stone; Mr. Charles R. Knight, and Mr. James L. Clark. The awards were as follows:

I. PHOTOGRAPHS OF MAMMALS IN THE WILD STATE

1st Prize	John M. Phillips	Mountain Goat
2nd Prize	Norman McClintock	White-tailed Deer
3rd Prize	Edmund Heller	Mountain Sheep
1st Honorable mention	Carl E. Akeley	Hartebeest
2nd Honorable mention	Donald R. Dickey	Deer
3rd Honorable mention	Kermit Roosevelt	African Elephant
4th Honorable mention	Edward Mallinckrodt	Brown Bear
5th Honorable mention	Donald B. MacMillan	Polar Bear

II. PHOTOGRAPHS OF MAMMALS IN CAPTIVITY

1st Prize	Elwin R. Sanborn	Chimpanzee
2nd Prize	J. E. Haynes	Bison Stampede
3rd Prize	W. Lyman Underwood	Bay Lynx
1st Honorable mention	Mr. and Mrs. Ernest H. Baynes	Wolf
2nd Honorable mention	J. B. Pardoe	Flying Squirrel
3rd Honorable mention	Joseph Dixon	Cougar Kittens
4th Honorable mention	Leland Griggs	Fox Head
5th Honorable mention	Arthur H. Fisher	Lioness

On November 20, 1921, the American Society of Mammalogists was constituted an affiliated society of the American Association for the Advancement of Science. At present 83 members of the mammal society are fellows of the American Association, which allows us one representative on the council of the Association. The Society will undoubtedly soon have among its members 100 fellows of the Association, when we shall be entitled to two representatives on the council of the Association. The by-laws of the American Association provide that members of affiliated societies have the privilege of becoming members of the American Association without payment of the usual entrance fee, if they make application before the second October 1 following their entrance into the Society. When a society first becomes affiliated this special privilege is offered to all of its members, the offer being open until the second October 1 following the ratification of the arrangements of affiliation. The Board of Directors elected the corresponding secretary to represent the Society in the council of the American Association.

The report of the corresponding secretary summarized the membership of the Society on May 16, 1922, thus:

Names of new members acted upon at this meeting.....	70
Subscribers added to Journal since May 3, 1921.....	18
Additional members and subscribers since May 3, 1921.....	88
Members May 3, 1921.....	527
Honorary members May 3, 1921.....	2
Subscribers May 3, 1921.....	62

Members delinquent 1920 dues May 3, 1921 (not receiving vol. 2 of Journal).....	41
Distribution of Journal May 3, 1921.....	550
Deaths of honorary member and members since May 3, 1921.....	4
Resignations since May 3, 1921.....	15
Dropped for delinquency May 16, 1922.....	24
Subscriptions cancelled since May 3, 1921.....	3
Members May 16, 1922.....	555
Honorary member May 16, 1922.....	1
Members delinquent 1921 dues, May 16, 1922 (not receiving vol. 3 of Journal).....	30
Lost addresses of members ¹	2
Members and honorary member receiving Journal, May 16, 1922....	524
Subscribers May 16, 1922.....	77
Distribution of Journal, May 16, 1922.....	601
Net increase in distribution of Journal since May 3, 1921.....	51

The program follows:

TUESDAY, MAY 16

Morning Session, 10:00 a.m.

Meeting of the Board of Directors

10:45 a.m.

Business Session

1:00 p.m.

The Museum entertained the members of the Society at luncheon in the Members' Room.

Afternoon Session, 2:00 p.m.

1. The present status of the elk. E. A. Goldman. Fifteen minutes. Lantern slides.
2. Mammals of the mountain tops. William L. Finley. By title.
3. The water supply of desert mammals. Vernon Bailey. Thirty minutes. Lantern slides.
4. The evolutionary force of a wide range. Ernest Thompson Seton. Ten minutes.
5. A quantitative determination of damage to forage by the prairie-dog, *Cynomys gunnisoni zuniensis* Hollister. Walter P. Taylor. Fifteen minutes. Lantern slides.
6. Studies of the Yellowstone wild life by the Roosevelt Station. Charles C. Adams. Five minutes.
7. The part played by mammals in the World War. Ernest Harold Baynes. Forty minutes. Lantern slides.

Evening Session, 8:00 p.m.

The members of the Society met at the new home of the Explorers Club, 47 West 76th Street, for an informal conversazione.

¹ Moses R. Cooper and E. M. Prutzman.

WEDNESDAY, MAY 17

Morning Session, 10:00 a.m.

8. The frequency and significance of bregmatic fontanelle bones in mammals. Adolph H. Schultz. Thirty minutes. Lantern slides.
9. A fossil dugong from Florida. Glover M. Allen. Ten minutes. Lantern slides.
10. Food-storing by the meadow-mouse. Glover M. Allen. Five minutes.
11. Certain glands in the dog tribe. Ernest Thompson Seton. By title.
12. The elephant in captivity. W. H. Sheak. Twenty minutes.
13. The burrowing rodents of California as agents in soil formation. J. Grinnell. (Presented by E. A. Goldman.) Twenty minutes.

Afternoon Session, 2:00 p.m.

Symposium on the Anatomy and Relationships of the Gorilla.

14. How near is the relationship of the gorilla-chimpanzee stock to man? W. K. Gregory. Thirty minutes. Lantern slides.
15. Notes on the comparative anatomy of the gorilla. G. S. Huntington. Thirty minutes.
16. Was the human foot derived from a gorilloid type? D. J. Morton. Thirty minutes. Lantern slides.
17. Reichenow's observations on gorilla behavior. J. H. McGregor. Twenty minutes. Lantern slides.
18. On the sequence of eruption of permanent teeth in gorilla and man. Milo Hellman. Fifteen minutes. Lantern slides.
19. Phylogenetic relations of the gorilla: evidence from brain structure. Frederick Tilney. Twenty minutes. Lantern slides.
20. The phylogeny of the human foot; the testimony presented by the friction-ridge configuration. H. H. Wilder. (Presented by W. K. Gregory.) Ten minutes.

6:45 p.m.

The members assembled at the Hotel San Remo for dinner.

Evening Session, 8:00 p.m.

21. The motion picture as a medium for intimate animal studies. Two reels. Arthur H. Fisher.
22. Motion pictures, some showing slow motion, of Anthropeidea, sea lion, Barbary sheep, kangaroo and yak, and the habits of the beaver. Three reels. Raymond L. Ditmars.
23. Adventures of a gray squirrel. One reel. G. Clyde Fisher.

THURSDAY, MAY 18

Morning Session, 10:00 a.m.

24. Close of the age of mammals. Henry Fairfield Osborn and H. E. Anthony. Twenty minutes. Lantern slides.

(This paper developed almost into a symposium on the subject with extensive remarks by W. T. Hornaday, W. D. Matthew, W. H. Osgood, C. C. Adams, and E. W. Nelson.)

11:30 a.m.

25. The American Museum of Natural History dedicated the North American Mammal Hall to the memory of the Society's only American Honorary Member, the late Dr. J. A. Allen. Professor Henry Fairfield Osborn, president of the Museum, presided. Among the speakers Dr. F. M. Chapman made a few remarks on the behalf of the American Museum and Dr. E. W. Nelson, president of the Society, presented an appreciation of Doctor Allen's service to natural history.

11:45 a.m.

Final Business Session

12:00 Noon

Members met at the American Museum of Natural History and were escorted by Dr. W. T. Hornaday to the Bronx Park, where they were the guests of the New York Zoological Society at luncheon at 1:30 p.m. at the Rocking Stone Restaurant. This was followed by a private view of the new halls of the National Collection of Heads and Horns and a tour through the park under the guidance of the officers of the Zoological Society.

—Hartley H. T. Jackson.

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CLOSE OF THE AGE OF MAMMALS

By HENRY FAIRFIELD OSBORN AND H. E. ANTHONY¹

The Age of Reptiles is estimated at 10,000,000 years by the thickness of sedimentary rocks. When the Age of Reptiles closed, land, air, and sea were left free for the rise of the mammals. The five surviving orders of reptiles were confined to the temperate and tropical zones and were only to a limited degree mammal destroyers.

The beginning of the Age of Mammals is estimated at 3,000,000 years ago. Out of very small and primitive progenitors, monotreme, marsupial, and placental, there evolved over the entire globe—land, sea, and air—a teeming mammalian life. Mammalian perfection reached its climax at the close of Pliocene time, about 400,000 years ago. The paleontologist follows this marvelous creation with wonder and admiration, as he traces the rise and adaptive radiation of twenty-four orders, one hundred sixty-six families, three thousand genera, fifteen thousand species, and its varieties of races of mammals.

The first effort at mammalian adaptation to land conditions in early Tertiary times was a failure; it was followed by natural extinction of five orders of mammals. The second mammalian adaptation culminated in the Upper Pliocene world and included man. This perfected Mammal World gradually diminished during the First, Second, and Third Glaciation, and suffered a terrible blow during the Fourth Glaciation, which led to the elimination of many superb races of mammals, and one or more of the inferior races of man. This was an extreme climatic change in which the Holarctic reindeer was driven down to

¹ This paper has been a year in preparation under the direction of the Senior author, who also contributes the introduction. The Junior author contributes the body of the paper on the fur trade, after a year of search and correspondence.

the 40th parallel, namely, 450 miles south of its present parallel. The reindeer gradually returned to northern Maine and to northern Scandinavia.

ELIMINATION BY MAN BEGAN 400,000 YEARS AGO

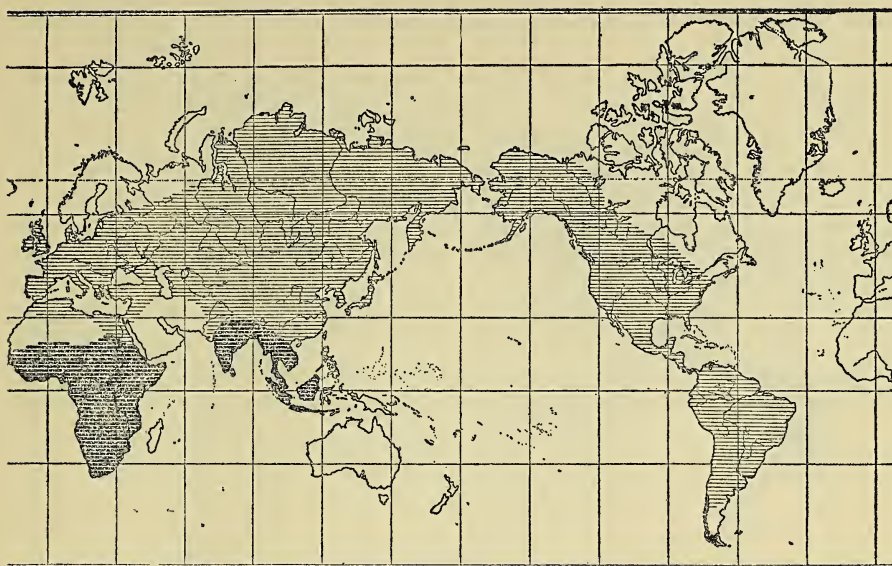
We may first review the story of civilization and extinction. In the struggle for food man sought flesh and marrow with primitive weapons of stone and wood. Man at this time was probably less destructive than most of the large predatory mammals. He killed with clubs, dug pits, rolled down rocks, etc.

The demand for clothing is very ancient, also beginning 400,000 years ago, furs and leather being utilized for clothing and footwear. The demand for bone and ivory utensils is also very ancient, the first bone tools being 40,000 years old, while the use of bone and ivory in art began between 25,000 to 30,000 years ago.

Cave men first employed light from burning animal oil and fat, and they also used fats in preparing pigments for personal decoration and in art. The demand for light culminated in the elimination of the sperm whale and other Cetacea and marine Carnivora. Five thousand five hundred whales have been taken in a single season from one whaling station in the Antarctic, and more than twelve thousand whales in a single season from the American Antarctic.

Agriculture is at least 20,000 years old. It is not known how early the value of animal compounds as fertilizers was discovered, but the *coup de grace* to marine life has been given by the fertilizer industry. In oceanic life the fate of the Cetacea and of marine mammals was sealed when the trade in spermaceti and in blubber oil was succeeded by the creation of fertilizer factories, which are rapidly eliminating the Cetacea. The other fur and hide-bearing marine Carnivora should enjoy the protection which is now being given the fur-bearing seals. The strongest appeal for the preservation of the walrus and the northern seals is the conservation of the natural food supply of the Eskimo.

Agriculture on land, the legitimate clearing of land and protecting of farms and gardens has been the next cause of elimination. The ranging of cattle and sheep over great areas, destroying winter food for game—sheep ruin whole watersheds because they devour all low vegetation and the bared hillsides have nothing to hold back melting snows for a normal gradual dissipation over the summer period—the killing of game by herd tenders, bounty systems against carnivora, and indiscriminate poisoning campaigns are all factors in the elimina-



DISTRIBUTION OF ELEPHANTS AND MASTODONS.



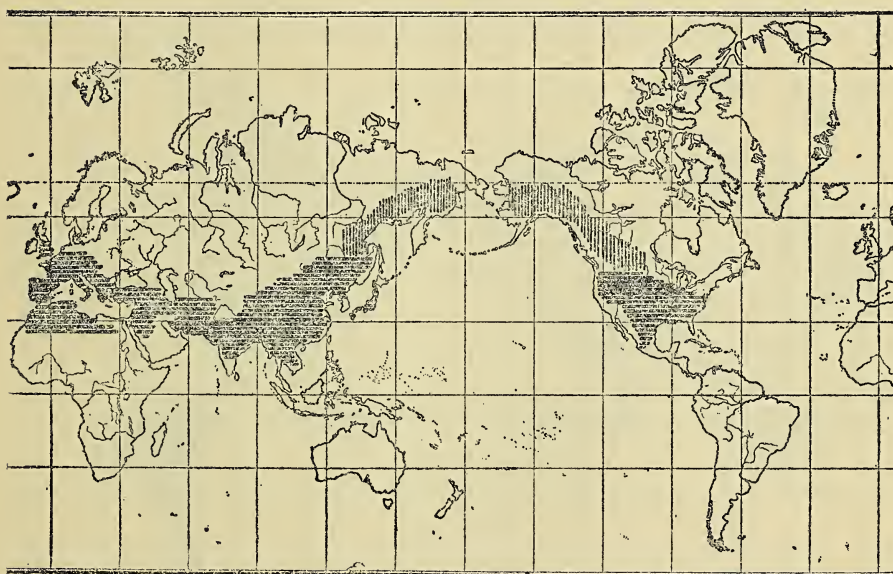
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FIG. 1

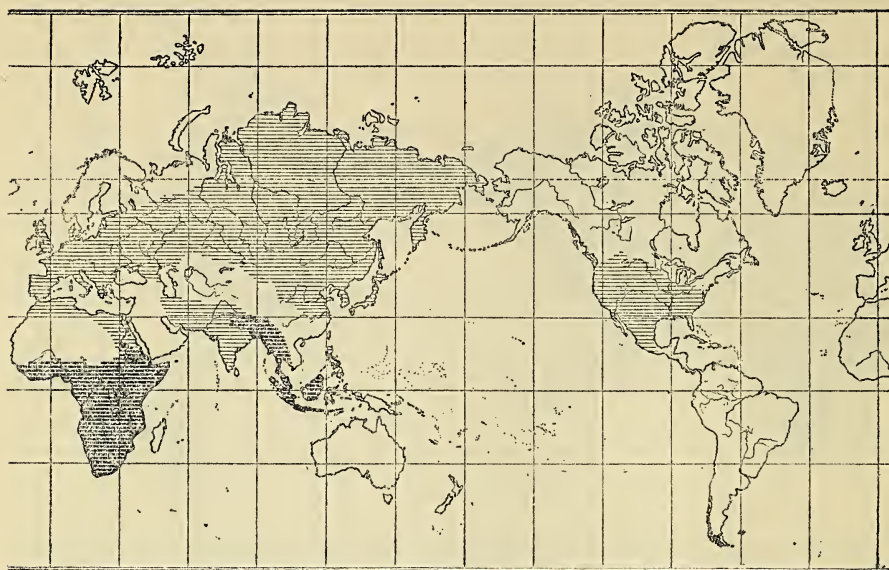



KNOWN
RANGE

KNOWN AND PROBABLE RANGE OF A SIMILAR MASTODON,
ELEPHANT, EQUINE, BOVINE, SABRE-TOOTH FAUNA IN UPPER
PLIOCENE AND LOWER PLEISTOCENE TIME.


PROBABLE
RANGE

FIG. 2



DISTRIBUTION OF RHINOCEROSSES.



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FIG. 3



DISTRIBUTION OF TAPIRS.



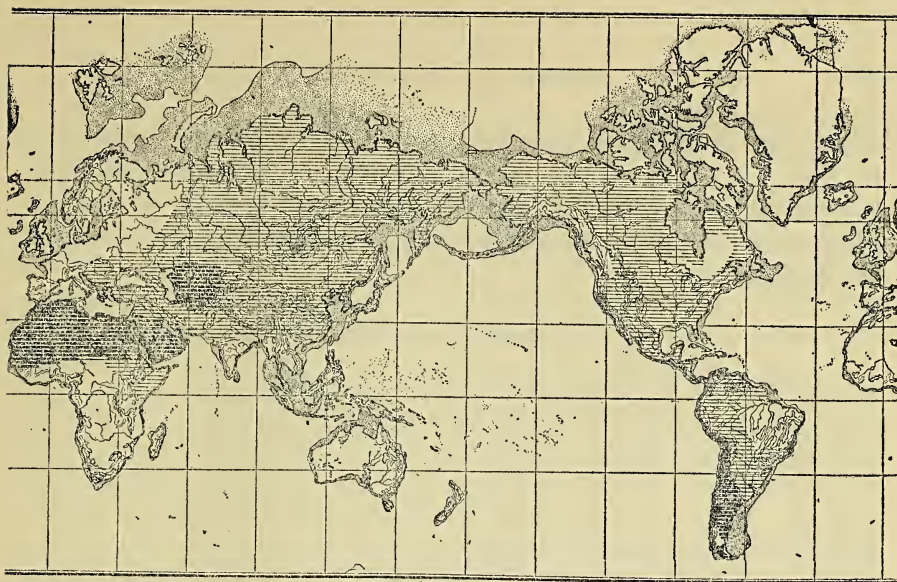
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FIG. 4



DISTRIBUTION OF CAMELS.



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FIG. 5



DISTRIBUTION OF HORSES, ASSES AND ZEBRAS.



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FIG. 6

tion of the mammals. Agriculture, the meat supply, and the fencing in of land is eliminating the game of Africa. Legitimate destruction by sportsmen had been comparatively a small feature. The meat market has been the chief cause of extinction of game animals throughout Alaska.

FORTY-FIVE YEARS OF PERSONAL OBSERVATION IN AMERICA

When Osborn first went to the Rocky Mountain region, as a young fossil hunter, in 1877, game animals were still universal. There was little agriculture and no barbed wire fences. Game was being killed off gradually by settlers and ranchmen, and, at times, ruthlessly by Indians. Bison were becoming scarce, but all the members of the deer family were extremely abundant and found wherever there was browse. With Sunday shooting he kept their fossil hunting camp supplied with meat—with mountain sheep, which were then in the Bad Lands, with antelope, and with black-tailed deer. Even as late as 1890, elk, deer, and antelope were extremely abundant in the uplands of Colorado. Elimination of game throughout this district is chiefly due to the winter supply of meat for ranchmen and, in a less degree, for the markets. All over the United States the legitimate meat for settlers and, to a limited degree, for the markets, has been the chief cause of elimination. Indians have come in and entirely cleaned out certain game retreats, like that of the Hell Creek region of Montana, which was full of game when Hornaday visited it in 1903.

Thus the three continents, Europe, North America, Asia, and finally Africa, have eliminated their wild animals through similar causes—the food supply, fur supply, industry and art, agriculture, deforestation, and, as a final blow but in a minor degree, sport. The number of game animals still surviving in the mountains of Asia is relatively great, but in many areas game is on the danger line.

RECENT DESTRUCTION OF FUR AND HIDE-BEARING ANIMALS

Nothing in the history of creation has paralleled the ravages of the fur and hide trade, which, with the bone fertilizer trade, now threatens the entire vertebrate kingdom. The legitimate use of furs for protection in cold weather has long since passed. Furs are now a fashion, just as feathers were thirty years ago. The trade has passed almost entirely into the hands of people of Oriental and Asiatic origin. Millions of dollars are spent annually in advertising. Furs are worn in

midsummer purely for ornament and personal adornment, or to make a display of wealth and luxury.

The final cause of the Close of the Age of Mammals can be arrested only through the creation of sound sentiment and education of the children and of women, in the same manner in which the National Association of Audubon Societies has arrested the destruction of birds. But such a movement will be extremely difficult, because the fur trade all over the world offers opportunities for money making, with very little effort and with no risk of life. Roy Chapman Andrews tells us that while he was in northern Mongolia word came through that marmot skins were coming into the market; the Mongols dropped all other work and began destroying marmots.

The best index to the destruction now going on among the mammals is afforded by a glance at the statistics of the fur trade. Anthony has compiled the figures for the years of 1919, 1920, and 1921, to show the large number of skins sold all over the country at the fur auctions, consulting a great number of fur-trade journals and reports. The best among these is the *Fur Trade Review*, a large monthly publication given over to everything of interest to the fur dealer. In the *Fur Trade Review* one can find a list of all offerings at the different fur auctions, and it may be assumed that these figures are sufficiently authentic to be used in this connection. In utilizing data of this nature, there are several features to be kept in mind. It is possible that the record of skins sold during any one year will not be a true record, inasmuch as, during a year of high prices, skins may be brought out of storage to be marketed under favorable opportunities, and in this way a large number sold during one year may have been collected over a period of several years. However, as we have had several "boom" years, it is quite likely that all of such stored skins have long since been brought out and disposed of, so that the more recent figures probably indicate animals killed within the year. Furthermore, lots of skins may be sold at the spring auction and shipped to another part of the country to be resold in the fall, consequently giving a duplication of numbers. In order to discount these figures and to keep them more conservative, we have omitted from the 1921 column the auction figures for the winter sale. This has, we believe, more than offset any duplication which may have occurred. The discounted total of all skins sold for the three years reaches the surprisingly large figure of 107,689,927 skins. Moreover, these figures indicate the slaughter of only the animals which reached the market as skins. To properly show the

slaughter that is taking place, one must allow for animals which were killed and not sent to the market because their skins were unprime, and also for a considerable percentage of wounded animals which escaped the trapper, but which, nevertheless, were killed through his agency.

	1919	1920	1921	TOTAL
Beaver, <i>Castor canadensis</i>	182,856	122,408	115,226	420,490
Muskrat, <i>Fiber zibethicus</i>	5,821,758	4,651,578	3,635,952	14,109,288
Nutria, <i>Myocastor coypu</i>	1,125,982	581,978	233,824	1,941,784
Squirrel, <i>Sciurus vulgaris</i>	6,304,777	5,109,181	3,444,358	14,858,316
White Hare, <i>Lepus sp?</i>	630,720	1,681,838	1,400,478	3,713,036
Mole, <i>Talpa sp?</i>	6,202,875	8,306,138	9,292,895	23,801,908
Mink, <i>Putorius vison</i>	704,148	575,265	404,487	1,683,900
Weasel or Ermine, <i>Putorius arcticus</i> .	1,199,901	1,210,726	1,081,785	3,492,412
Kolinsky, <i>Mustela sibirica</i>	379,641	318,724	453,188	1,151,553
Skunk, <i>Mephitis sp?</i>	3,660,430	553,001	2,682,243	6,895,674
Alaska fur seal, <i>Callorhinus alascanus</i>	20,870	18,525	45,769	85,164
Wolf, <i>Canis sp?</i>	370,603	395,371	328,528	1,094,502
Red fox, <i>Vulpes fulvus</i>	348,875	531,433	414,950	1,295,258
Silver or Black Fox, <i>Vulpes fulvus</i> . .	11,709	7,547	7,094	26,350
Civit cat, <i>Spilogale sp? Viverra sp?</i>	906,553	601,177	606,805	2,114,535
Raccoon <i>Procyon sp?</i>	618,382	677,215	418,103	1,713,700
Sea Otter, <i>Latax lutris</i>	15	31	30	76
American Opossum, <i>Didelphys</i>				
<i>virginiana</i>	2,565,418	3,471,627	3,750,697	9,787,742
Australian Opossum, <i>Phalanger sp?</i>	1,133,917	2,061,349	1,070,355	4,265,621
Ring-tail Opossum, <i>Pseudochirus and</i>				
<i>Phalanger</i>	282,239	559,649	479,737	1,321,625
"Wombat" (Koala), <i>Phascolarctus</i>				
<i>cinereus</i>	2,998	121,435	84,244	208,677
Kangaroo, <i>Macropus sp?</i>	2,400	16,443	22,395	41,238
Wallaby, <i>Macropus sp?</i>	565,318	693,369	463,901	1,722,588
Total	33,042,385	32,266,008	30,437,044	95,745,437

A glance at some of the noteworthy species sought by the fur trade will show something of the scope and demands of this industry. Altogether, the fur trade utilizes, at the very least, some one hundred twenty-five species, the exact number being difficult to determine because of the employment of trade names, which mean nothing to the zoologist. We have included in the table with this paper only the more important species.

The figures showing the number of beaver (*Castor canadensis*)² taken demonstrate what proper protection of a fur-bearing species may do. Formerly trapped all over the continent, beaver were brought almost to the point of extermination, but for many years they have been protected and allowed to increase unmolested; now, over a period of three years past, some 420,000 skins have come to market. The muskrat (*Fiber zibethicus*) figures indicate how relentless has been the pursuit of this small rodent, an animal which at one time brought such a low price at the sales that it was scarcely worth while to trap it. When muskrat fur came into fashion and the public demanded it, systematic campaigns of trapping began, which brought muskrat skins to the market by the millions and seriously threatened the very existence of this species. Squirrel (*Sciurus*) skins, most of which we believe have come from the Old World, make up a huge total of over fourteen million in number, and this is another example of a skin, formerly very slightly valued, coming into prominence because of the demands of fashion. Still greater numbers are shown by the mole (*Talpa*). The skin of the mole is so small that only since the interest in furs has become extreme has there been any incentive for men to molest it. Most of the skins sold at these sales must come from the Old World, and the mole, as any one knows who has tried to trap it, is an exceedingly difficult animal to capture. Over twenty-three millions of these little animals were sacrificed at the altar of the fur trade. The mole, it may be claimed, is a small, insignificant species, and here and there along the list of fur bearers are animals for which little good or economic value may be urged, but the presentation of this subject is intended to show the great destruction of mammal life irrespective of species and the desirability of the extermination of any animal does not enter into the discussion.

The mink (*Lutreola vison*), which has been one of the favorite furs in the market for many years, is an animal which apparently is nowhere to be found in very great numbers. However, since its skin has brought such a good price at auctions, the country has been combed over for mink and the annual average yield of the last three years shown has been over five hundred thousand skins. This means a very serious

² The scientific names used throughout this article are those under which the animal is best known to the general public and to the fur trade. Recently accepted changes in nomenclature have been avoided because of confusion which might arise in the minds of those who have known these animals under the older names.

tax upon the ability of the animal to maintain itself. Ermine (*Putorius arcticus*) has been worn from time immemorial and has been the fur of royalty, and no less than 4,400,000 of these little animals have come to market over the three-year period. Before the recent craze in furs had begun, the skunk (*Mephitis*) enjoyed the immunity which nature intended him to have, and his skin brought such a low figure at the auctions that it scarcely paid to run the risk of removing it. Now skunk fur commands such a high price that the trappers refuse to be balked of their prey and over six million skunk were disposed of at the auctions from 1919 to 1921. When the killing of the Alaskan fur seal (*Callorhinus alascanus*) had reached such serious proportions that the government found it necessary to take a hand, and treaties had established the right of this country to protect the fur seal, the northern herds were placed upon a basis of protection and the annual killing controlled by law. This has been found to work out most satisfactorily, and a glance at the figures shows that over the three-year period more than eighty-five thousand skins were sold—a very satisfactory total when one considers the high prices per individual skin.

The average man may be led to suppose that wolves have become almost extinct over most of the country. In the figures given for the wolf (*Canis*), there are lumped together a great many species of coyotes and wolves, but, even so, the very large total of over one million skins is very significant of the great campaign that is being carried on against this animal, and at this rate it will not be very long before the wolf is extinct indeed. The red fox (*Vulpes fulvus*) has been such a prime favorite that great numbers of his skin have come to the fur sales, and we understand that in some regions of the north the fox is virtually on the brink of extermination. Over one million two hundred thousand skins taken during the three-year period point out a rate of destruction far greater than a species like the fox can survive. On the other hand, the rarer foxes, the silver and the black, have been protected and reared in captivity, and we have learned upon good authority that most of the skins sold at the sales are those of ranch reared animals. When upwards of twenty-six thousand ranch reared skins can be sold in three years, this furnishes a significant point for the consideration of the proper methods for supplying the fur market.

The raccoon (*Procyon*) is another animal which had but little fur value in early years; but to show how his status has changed, it will only be necessary to point out a total of 1,700,000 skins for the three-year period. The sea otter (*Lutra lutris*), the most beautiful of all

furs, came to the fur counters to the extent of only seventy-six specimens, and this is a sad commentary on the disappearance of this animal. Inasmuch as the animal is protected over most of its known range, some of these specimens were doubtless taken illegally, and unless some radical change for the better takes place, it will not be long before the fur dealers must do without the sea otter.

One of the most widely sold furs is one which was formerly worth but a few cents and was seldom skinned by anyone but boys. We refer to the American or Virginia opossum (*Didelphys virginiana*), which, since it has come into fashion, has been skinned to the number of 9,700,000. The Australian marsupials have known to their cost this increased demand for opossum, and the drain upon the wild life of Australia is shown by the total of over four million for the so-called "Australian opossum,"—several species of small marsupials (*Phalanger*) going under this name—a total of more than one million three hundred thousand skins for the ring-tailed opossum (*Phalanger* and *Pseudochirus*), and more than two hundred and eight thousand skins for the koala (*Phascolarctus cinereus*), or, as it is known in the fur trade, the wombat. This latter animal has a skin almost worthless, when considered from the viewpoint of beauty and durability, but the fur traders have not passed up even so poor a fur bearer.

The Australians have been anxious to conserve their wild life and have shown this in their restriction of the number of native mammals which they have allowed scientific expeditions to take, but, on the other hand, their trappers have shipped out through the principal ports literally ton upon ton of baled skins, and whole regions have been stripped of the mammal life, so that Mr. W. H. Dudley Le Souef says some of the species have been brought down so close to the danger point that a year of drought will exterminate them completely over large areas.

The figures just cited give a little insight into what the fur trade is doing toward bringing about the Close of the Age of Mammals. In a few years some of the mammals now sought by the trappers will be killed off to a point where they will not repay trapping—the numbers taken being insufficient to repay for the expenditure of energy. Mammals are frequently subject to the attacks of different parasites, and are very susceptible to the spread of different epidemics. When the balance of nature has been disturbed and a species is brought to the point where the struggle for existence is precarious, it may happen that a species will disappear completely; in other words, be exterminated

by the appearance of some natural factor which it has been amply able to resist before its numbers were depleted by the demands of the furriers.

In Africa a number of animals have reached this point. Some of them have been killed off by natural causes, and others by the development of agriculture and by firearms in the hands of natives. In Africa epidemics appear to have unusually favorable facilities for spreading and many of the ungulates are standing upon the brink of disappearance. Mr. Herbert Lang has given us the names of the more important of the African mammals which have either disappeared or are about to disappear. We mention the quagga and the blauwbok, which have disappeared completely, while the mountain zebra, the bontebuck, the white rhinoceros, the okapi, the black wildebeest, the greater kudu, and the elephants of the Addo Bush are about to join them. The elephants of the Addo Bush are being systematically exterminated under government supervision, and the story of their downfall has been given in Hamlyn's *Menagerie Magazine*.

The center of the fur trade has passed over to this country. Before the war London was the world's fur market, but it now appears that the control has definitely passed over to the United States, and the great market of the present day is here with us. The figures given out by the Fur Dressers and the Fur Dyers Association show that in New York alone over eighty million skins were dressed and over ninety-seven million were dyed by the members of this association for the years 1918, 1919, and 1920. Thus it would appear that the heart of this industry beats in our own country, and if there is to be any prescription written, the initiative should be taken by us. The fur dealers themselves, for the most part, seem to realize that the wild animals are an asset of their industry, and judging by the editorials of the different journals, and the articles that appear, we believe that the majority of them, if the matter were put to a vote, would encourage a better method of trapping and a more extended control over the wild animal supply. It would suit their own purposes better if animals could be taken only during that part of the winter when they were prime; and the restriction of the hunting period to such a time of the year would be an important first step toward the conservation of fur bearers. But as matters now stand, when fur prices begin to mount to such figures that a few skins represent many dollars, then in the out of way places where laws have little significance at any time, men go out and kill every fur bearer that may come to hand, and run out their traps for whatever they may catch.

Therefore, we believe that if some more drastic methods of checking this perfectly appalling slaughter are not soon inaugurated, the fur industry will have been the means of quite definitely closing the Age of Mammals insofar as it applies to a number of species.

DISCUSSION BY PROMINENT MAMMALOGISTS

At the conclusion of the paper, Dr. W. T. Hornaday, director of the New York Zoological Park, who is the foremost advocate of wild life protection in the world, arose and commented on this joint paper. He began his remarks by stating that he thought Professor Osborn was entirely within bounds in saying that we were at the close of the Age of Mammals; that to his mind there was nothing more terrible to contemplate at this time than the grinding and devastating power of modern civilization as it is exerted, not only on animal life generally, but on vegetable life and on all the products of nature; that the human race is increasing and spreading, and it is also increasing in its power and ingenuity to destroy. The Zoological Society receives reports and communications from a great many far-distant portions of the world, where there is today the greatest abundance of animal life, and the story that is told by that correspondence everywhere is the same. It is the story of the continuous and alarming disappearance of the most important wild animal forms.

Taking Africa as an example, Doctor Hornaday said that a new influence has been brought to bear on the wild life of British East Africa, and of South Africa for that matter. The British government has been sending to British East Africa a great many ex-service men. They have been located there on farms, where they practically subsist on the resources of the country, living, to a great extent, on the game. Many of them are killing game wantonly, which they are well equipped to do, and none of them, he thinks, are preserving game. He stated that the Zoological Society had received most alarming reports from South Africa and from the Egyptian Soudan, and he continued as follows: "We are in close touch with men in the Union of South Africa, who are deeply interested in preserving the remnants of Africa's magnificent mammalian fauna and who will do all they can, under the tremendous handicaps that are upon them, to stem the tide of destruction. We have been called upon for practical assistance and the Permanent Wild Life Protection Fund is now on the point of sounding an alarm gong throughout South Africa, chiefly for the purpose of attempting to arouse the people of South Africa to the danger that besets their best, most interesting, and most vital wild life. Mr. Anthony has named to you a number of important species in South Africa that are threatened. It is no exaggeration to say that the kudu, the white rhinoceros, of course, and many others that could be named, are on the point of total destruction. Here in the United States we are engaged in a hand to hand struggle to save the pronghorn antelope from going down and out as a species, in spite of our efforts, and literally before our eyes. I think that there never has been an American species which has been so persistent in getting on the toboggan slide of its own accord as the pronghorn antelope. It is delicate in body. It is easily exterminated in the wild state, and now every tendency of civilization is to destroy it."

Doctor Hornaday then discussed the efforts of the American Bison Society to save the remnants. Taking the case of the state of Wyoming, he stated that the governor of Wyoming had said that the antelope is being destroyed by the homesteaders who have gone in there — in some instances having been induced to go in when they should not have gone — to locate on semi-arid lands; that in trying to live without irrigation and without any resources what ever of their own, and being hard pressed for food, they are killing the antelope and every other wild animal that they can reach; that there is no way of stopping it, there are so many of them that the state could not put in enough game wardens to prevent them from killing the animals. The governor is so thoroughly alarmed that he is now proposing a special state game preserve for the antelope. Doctor Hornaday believes that the handicaps on the antelope and the handicaps on those who will try to save it are so numerous and so great that the antelope is doomed to go down and out in about twenty-five years. The trouble is, when the antelope seems to be doing the best, something comes along and, in a twinkling, all is changed for the worse.

He stated that in far-distant countries, inhabited by savage tribes, it is now a lamentable fact that the natives are acquiring modern firearms. In India, forty years ago, the natives were not permitted by the Government to have firearms or to hunt with them. Now they have just as good breech-loading rifles as the English sportsmen, and they are using them very generally, and the English sportsmen say the game in India is being rapidly annihilated.

Doctor Hornaday continued as follows: "We must think in decades, quarter-centuries, half-centuries, and centuries. Geologic time is not for us. We are approaching the complete destruction of our wild life at express speed, and the rapidity with which the fauna and the best wild life of the world, that is, the mammal life of the world, is being destroyed, is ground for the most gloomy foreboding and confirmed pessimism. There are many far-sighted men and women who are doing their utmost to stem this tide of destruction and to save the depleted remnants for posterity. But what does it amount to? We may as well face these facts like men. We should not deceive ourselves. As a matter of fact, for every person who is putting forth active efforts to preserve the mammal life of the world, there are from one thousand to ten thousand, or even a hundred thousand destroyers. I have been devoting some thought recently to that subject. In the state of New York we have figures available. I have figured it out that in New York state, for every person who is actively engaged in preserving the mammal and bird life of the state, there are five hundred destroyers. In the West I think the number will be 1 to 1000; in Alaska I think it is about 1 to 2000; that is to say, for every person who is laboring to preserve the wild life, there are 2000 destroyers. In Africa, what shall we say? I should imagine that for every person on the continent of Africa who is attempting actively to preserve wild life there are 100,000 persons destroying it. We know that the great game preserves that are being created and protected at such great expense by the nation, by the states, by private individuals, and by a few other countries, will do something toward preserving some of these species from total extinction."

Doctor Hornaday stated that there are thoughtful men, of whom Mr. Madison Grant is one, who believe now, and have believed for some years, that a time will soon come when there will be no big game remaining in the United States or on the

continent of North America, save in the patrolled game preserves, and that he was fully convinced that this is true, and the only thing that is questionable about it is the number of years that will elapse before this is actually the state of affairs.

Doctor Hornaday believes we must not be discouraged in our efforts to preserve the remnants of the once glorious mammalian fauna. It is our duty to fight for it as long as we live. The close of the Age of Mammals may be ever so certain, but we have a right to hope that somehow and somewhere, in various places, fortune will favor our efforts. He said that the fur trade was doing its utmost to destroy everything that by any stretch of the imagination can be regarded as fur; that the destruction of the life of fur bearers has reached such a state that it is simply disgusting, and that there is no animal too mean or malodorous to be used by the fur trade.

Doctor Hornaday concluded by saying that he had far exceeded the time he had intended to speak, and that he closed as he began, by expressing his firm conviction that Professor Osborn and Mr. Anthony were absolutely right in saying that we are at the close of the Age of Mammals.

Dr. William Diller Matthew, chief of the Division of Geology and Palæontology of the American Museum, who has made a commanding study of the life of animals of the past and the natural causes of extinction, was then called upon to discuss the paper, and remarked, that, to his mind, the distributional maps that Professor Osborn had shown and the statistics that Mr. Anthony had placed before the meeting told the story of the disappearance of the great animals very impressively, and demonstrated one of the principal causes, at all events, for their disappearance. He said: "I do not think that one can fail to be fully convinced from these maps and figures. I think, however, that the maps and figures have underestimated the facts, if anything, as to the former great abundance and variety of animal life, and especially of the large animals. It is to be remembered that those comparisons are based only upon such types as have been found. There are many records of fossils in various parts of the world; but at the same time we are far from having explored any part of the earth's surface thoroughly. There is no country in the world in which, during the last few years, explorers have failed to discover many new extinct types that have been wholly unknown; and skulls or skeletons of other types that have either been slightly known from small fragments, or have been regarded as animals having no real existence, merely products of the scientist's imagination or the itch for species making. In half a century from now we will look back at our present knowledge of the Pleistocene and Pliocene life of the world with the same amusement with which we read in the older textbooks the large words that cloaked the ignorance of fifty years ago. The plain fact is that we know very little, even yet, of the great varied mammalian fauna that inhabited the six continents at the end of the Age of Mammals.

Doctor Hornaday has shown the impending extinction—and extinction that seems almost unavoidable—of the pronghorn antelope. It is an animal that for various reasons we believe must be a solitary survivor of what was formerly a more abundant and varied group of animals. We have had no real evidence of that until comparatively recent years. We have at present three extinct relatives of the pronghorn antelope recorded. In the course of discovery of the next

half-century we may develop as large a variety of pronghorns and their relatives in this country as we have of true antelopes in the Old World.

I have given this instance of the pronghorn antelope simply to show that the Pleistocene and Pliocene mammal faunæ were really of great richness and variety, and it is, therefore, no exaggeration to state that there has been a very great reduction in the mammal fauna when we pass down to the mammals of today.

Dr. W. H. Osgood of the Field Museum of Natural History was then called upon and after agreeing with previous speakers, contributed a few further remarks to the discussion, giving his own impressions as to the contrast between conditions in settled regions and what one finds in going to those which have been practically uninfluenced by the forces of modern civilization. He stated that this had been his privilege upon one or two occasions in South America, where he had happened to penetrate into some of the few regions where Indians are still hostile and where conditions and surroundings might be said to be almost as they have been from the beginning. He had been particularly impressed in these regions with the very great abundance of animal life of all sorts, and especially of those kinds upon which man might be said to prey. Birds of large size, as ducks and gallinaceous birds, were found in such places to be as abundant as they were in this country when it was first settled, and he thought that this could also be truthfully stated about the members of the deer family and other groups of mammals. Such experiences bring an acute realization of the rapid changes that are taking place.

Dr. Charles C. Adams of the Roosevelt Wild Life Experiment Station, at Syracuse, added the following comments upon the Close of the Age of Mammals: He regretted the terrific destruction which was going on and stated that conditions surely demanded improvement. His solution of the difficulty would be to use the forces of education and the widespread use of preserves making these the main means to help stem the tide. This education should not be content to deal only with adults, because unless it began before maturity—with the younger generation—it would be useless. And neither did he think that such education could be limited to the Audubon Society, which is a specialized society for birds. There is an urgent need, he said, of an organization upon a conservation basis that will begin at the bottom and cover thoroughly the whole field. And this means also that the idea of preserves must be developed on a very large scale. Doctor Adams believed that the preserve idea is a most constructive feature, especially if some of the federal land be segregated and administered by the Central Government supplementing the National Parks and National Forests. The carrying out of this idea would mean an increase of our state parks and forests on a plan hardly dreamed of at the present time. Not only is there a call for large game preserves, but small game preserves and wild life or natural history sanctuaries must be established, since the purpose of education would not be served by a few large preserves which would be at a distance from the larger part of the population. The preserves must be so located that people may be taught the conservation of wild life near at home.

Another point that Doctor Adams brought out is the necessity for learning more of the life habits of the mammals; as a necessary condition for their intelli-

gent preservation and public appreciation. It would be only a partial remedy to establish preserves unless we know more about the habits of the mammals which we hope to protect in these preserves, and it is highly essential that more attention be paid to this intimate detailed knowledge of life history and ecology of our mammalian fauna. It is this aspect of natural history that has the greatest popular appeal and is most intimately related to economic problems.

He believed that men are coming to realize more and more the threatening features of the destruction of mammal life. There seems to be a feeling that opposition to this destruction is almost hopeless; that there is no use trying to stem the tide. While Doctor Adams granted that the problem is sufficiently discouraging, he regarded it in the same light as he did the question of our liberty, in the best sense of the term. Our liberty or our opportunities for living is a thing to be protected at any price, and the struggle for its protection must not be relinquished at any time. We cannot save wild life unless we go about it with the same earnestness and with the same refusal to acknowledge defeat that we would employ in the protection and conservation of our liberty. It is a similar unending process of adjustment to our conditions of life.

The discussion was brought to a close by the comments of Dr. E. W. Nelson, chief of the Biological Survey of the United States Department of Agriculture, charged with the Federal activities in relation to game and other mammal life. Doctor Nelson stated that the Biological Survey is engaged largely in the work of conservation and he has been more and more impressed, especially during the last few years, with the difficulties, and in some instances the apparently insurmountable difficulties, in the way of saving any considerable share of the existing large mammals of the world.

The rapid progress of modern civilization of man has accelerated the downhill procession of the other important mammals. Primitive man was simply one of the various predatory animals which preyed upon the coexistent animal life. At that stage man, like other mammals, was subject to the vicissitudes of his environment. Diseases or severe drouths or other inclement climatic conditions and other causes which destroyed wild life in general also destroyed a similar proportion of primitive man, thus retaining a balance in numbers which prevented the extermination of the animal life on which man preyed.

With the acceleration of modern civilization the powers of man to exterminate the wild life about him have increased marvelously, with the modern improvement of weapons and means of locomotion, which have been accompanied by the taking over of enormous areas of forests and plains for agricultural purposes. This has been accompanied by rapidly increasing populations and with an amazing increase in the number of hunters which go afield each year making a total annual bag of extraordinary proportions.

As a result of an inquiry of the state game wardens throughout the country it appears that in 1921 hunting licenses were issued to more than 4,000,000 hunters, while in many states landowners may hunt without a license. This with the number hunting in a few states which do not require licenses will undoubtedly increase the number of hunters who went afield in that year to exceed 6,000,000. The fact that any game survives after the hunting season in which such an army goes forth to shoot is amazing.

The main danger to wild life, however, has not been from hunting for sport or for individual use, but has been largely due to the commercial use of game, and its extermination to make way for the occupation of its territory by man. The commercial pursuit of game and other mammals for one purpose or another has made use of many improved methods of killing and transportation, until to-day the urgent need of limitations to such destruction of our wildlife asset is obvious. Attempts to conserve our wild game by the prohibition of its sale for commercial purposes, the establishment of bag limits and of closed seasons, and other legal methods, have been effective in delaying extermination. Public education as to the needs of a reasonable use of our wild life is also becoming more and more widespread.

As an instance of the demands of commerce for wildlife products may be cited the rise in value of muskrat skins until in 1920 they sold in Montreal at \$7.50 each. The result of such prices was that muskrats were practically exterminated over great areas. Similar high prices for furs and an insistent commercial demand for them will menace the existence of all fur bearers not effectively protected by law.

In some areas, as in the State of Pennsylvania, an enormous amount of game is killed each year owing to the establishment of a considerable number of state game sanctuaries which serve as breeding grounds as well as refuges. Doctor Nelson believes that this is significant in indicating possibly a practical solution of the problem of wildlife conservation to the degree which the occupation of the states as a whole by man can permit.

For some years, he stated, the Biological Survey, with the United States Forest Service, has been working with the stock growers' associations of the West to bring about some agreed-upon policy for the conservation of game on the national forests, where vast numbers of domestic stocks are grazed. Many stockmen have taken the attitude that game is a nuisance since it takes some of the forage which stock might use. In addition, many stockmen have feared that game conservationists might desire to crowd domestic stock off the ranges in order to devote them to game. He believed that the movement among the stock growers was beginning to make headway, since at the last meeting of the National Stock Growers' Association, in Colorado, a resolution was passed recommending that study of game conditions on the national forests be made in order to work out a policy whereby game might be maintained along with the live stock. This is an extremely encouraging development.

Doctor Nelson agreed with Doctor Hornaday that the conservation element is a small minority and that they must keep everlastingly at the problem if they are to succeed. Discouraging reports of frightful slaughter are continually coming and these are not helpful to the morale of the conservation element. Indians have considered it their special privilege to kill wild game at will. He believes this source of destruction is a special danger which it is peculiarly difficult to avert in Alaska and northern Canada.

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NOTES ON TERTIARY SIRENIANS OF THE GENUS
DESMOSTYLUS

BY HAROLD HANNIBAL

[Plates 11-12]

During the past four or five years I have collected numerous teeth of extinct sirenians of the genus *Desmostylus* from the Miocene and transitional Oligocene-Miocene beds near San Jose, California.

The teeth of *Desmostylus* are of a unique type. When the tooth emerges from the gum it is made up of cone-shaped columns of enamel filled with dentine. As it wears it becomes a group of closely appressed enamel rings surrounding pits from which the dentine has been eroded.

A number of teeth together with bones and fragments of tusks were found in company with marine invertebrates in shell-limestone intercalated with the lower or buff sandstone member of the San Pablo formation on the San Jose Quadrangle between Monument Peak and the saddle where the road to Calaveras Valley crosses the first ridge of the Diablo Range. At a horizon only a few hundred feet higher a tooth was found in shell-limestone about a half a mile south of the saddle where the road to Mount Hamilton crosses the first ridge. A fragment of a *Desmostylus* tooth was also found in a mixture of limestone and rhyolite tuff interbedded with Monterey shale on the New Almaden Quadrangle northeast of the Guadalupe quicksilver mines. It was associated with *Pecten andersoni* Arnold and therefore comes from beds considerably older.

Desmostylus hesperus Marsh¹ on which the genus was founded was described from fragments of teeth and vertebræ collected by L. G. Yates in the Miocene of either Alameda or Contra Costa Counties, California. While the exact locality where the type was collected will probably never be known, the figure compares closely with a molar fragment found at the Monument Peak locality which lies only a few miles to the south. At several points in the San Pablo beds of Alameda and Contra Costa Counties I have seen fragments of vertebræ that I took to be sirenian remains and it is probable that Marsh's material came from this horizon.

The teeth from Monument Peak come from different parts of the mouths of many individuals. The most common teeth are first molar

¹ Marsh, O. C.; Am. Jour. Sci. Arts, CXXXV, pp. 94-96, fig. 1-3, 1888.

with seven columns and second and third molars with eight or nine columns, but the collection includes a milk molar with seven or more columns and two milk incisors, slender unicolumnar teeth. Fragments of two tusks having a length exceeding twelve inches and a diameter of an inch and an inch and a half, respectively, were obtained. They were found together and it is believed that they came from a lower jaw that may have held four tusks.

A second species of *Desmostylus* is found in Japan. In 1902, Yoshiwari and Iwasaki² described and figured a skull from the Miocene of Togari, province of Mino, which was subsequently named *Desmostylus watasei* Hay.³ It differs from *Desmostylus hesperus* chiefly in the small anterior columns and heavier enamel of the molar teeth.

A third species occurs in the Oligocene of California and Oregon. In 1906 and 1911 Merriam⁴ announced the find of teeth and tusk fragments of an unnamed *Desmostylus* in southern California, the San Joaquin Valley, and Yaquina Bay, Oregon. He figures (1911, p. 407, fig. 1a-1b) a molar tooth from the Monterey formation north of Coal-inga (nw. $\frac{1}{4}$ sec. 29, T. 18 S., R. 15 E.) which belongs to the same section of the genus as *Desmostylus watasei*. Recently Hay⁵ has figured as *Desmostylus hesperus* a skull and teeth from the mouth of Spencer Creek,⁶ Yaquina Bay, Oregon. The molar teeth are characterized by heavy enamel, small dentine cores, and slender anterior columns as in *Desmostylus watasei* but the Yaquina skull is only about half the size of the Japanese skull with five columns instead of eight to the first upper molars and a corresponding reduction in other teeth.

Since the species is unnamed I propose to call it *Desmostylus cymatias* Hannibal, n.sp., from Cape Foulweather near where the Yaquina skull was obtained.

² Yoshiwara, S. and Iwasaki, J.; Jour. Coll. Sci. Imp. Univ. Tokyo, XVI (6), pp. 1-13, pls. I-III, four text figs., 1902.

³ Hay, O. P.; Proc. U. S. Nat. Mus., XLIX, p. 396, 1916.

⁴ Merriam, J. C.; Science, XXIV, pp. 151-152, 1906; Univ. Calif. Publ. Geol., VI, pp. 403-412, 11 text figs., 1911.

⁵ Hay, O. P.; Proc. U. S. Nat. Mus., XLIX, no. 2113, pp. 381-397, pls. 56-58, 1916.

⁶ I am unable to locate Spencer Creek no available maps but it cuts an area of Seattle shale and Monterey sandstone which are of Oligocene and Oligocene-Miocene age. Cf. Arnold, R. and Hannibal, H.; Proc. Am. Phil. Soc., LII, no. 212, pp. 582, 587, pl. XXXVIII, 1913.

The stratigraphic range of the three species is shown in the following table.

	CALIFORNIA	OREGON	JAPAN
Middle Miocene	<i>D. hesperus</i> in San Pablo formation of Monument Peak near San Jose		
Oligocene-Miocene	<i>D. cymatias</i> in Monterey formation north of Coalinga	<i>D. cymatias</i> in Monterey or Seattle formation at Yaquina Bay	<i>D. watasei</i> in Miocene of Togari, province of Mino

EXPLANATION OF PLATES

PLATE 11

Desmostylus cymatias Hannibal, n. sp.; Yaquina Bay, Oregon (after Hay, Proc. U. S. Nat. Mus., XLIX, pl. 58).

FIG. 1. Skull from left side. $\times \frac{2}{5}$. Explanation of numerals: 1, supraoccipital; 2, parietal; 3, frontal; 5, premaxillary; 6, maxillary; 7, lachrymal; 8, squamosal; 9, zygoma; 10, jugal; 11, capsule for second molar; 13, exoccipital condyle; 17, mastoid, 18, palatine; 27, tympanic cavity; 28, infraorbital foramen; 29, exoccipital.

FIG. 2. Skull from rear. $\times \frac{2}{5}$.

FIG. 3, 4. Supposed second molar. $\times 1$.

FIG. 5, 6. Supposed fourth premolar. $\times 1$.

PLATE 12

Desmostylus hesperus Marsh, $\times 1$; Monument Peak, San Jose, California.

no - 5118 - FIG. 7. Fragment of a little-worn molar comparing closely to Marsh's type.

5119 - FIG. 8, 9. Worn second or third molar.

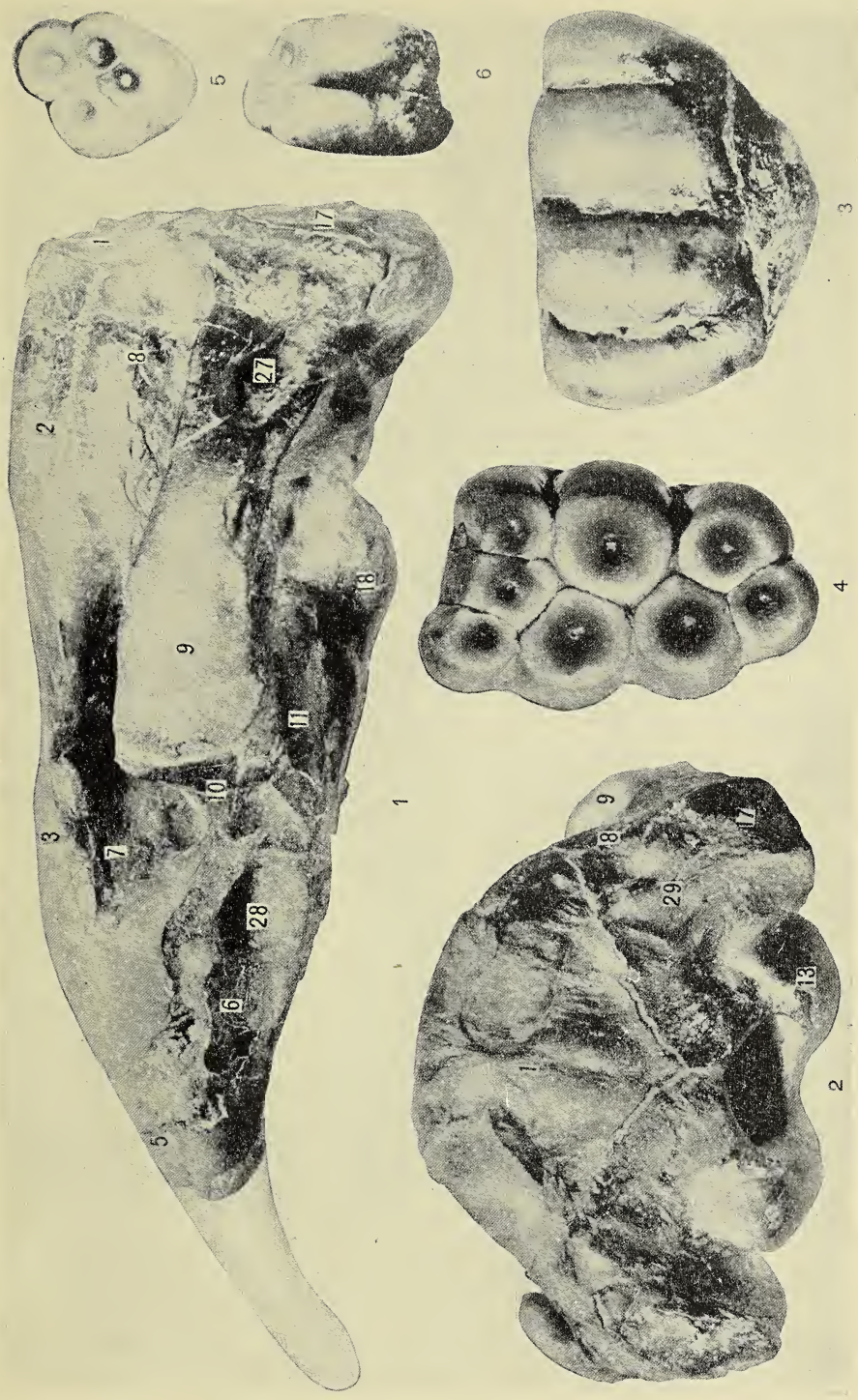
5120 - FIG. 10. Partly-worn second or third molar from another part of mouth.

5121 - FIG. 11. Partly-worn first molar.

5122 - FIG. 12. Fragment of an unworn milk molar which originally had seven or more columns.

5123 - FIG. 13, 14. Fragments of unworn unicolumnar teeth, probably milk incisors.

Stanford University, California.



DESMOSTYLUS CYMATIAS HANNIBAL

(Hannibal: Tertiary Sirenians.)



DESMOSTYLUS HESPERUS MARSH

(Hannibal: Tertiary Sirenians.)

THE GENUS NEOTOMA IN THE SANTA CRUZ MOUNTAINS

BY HAROLD E. PARKS

Wherever he goes in the hills and woods of the Santa Cruz Mountains, California, sooner or later will the camper become acquainted with the little rodent commonly known as the woodrat. Not so much will he see of the animals themselves as of their astounding activities. To the camper, the woodsman, and the rancher the woodrat becomes a nuisance and a serious pest. Destructive to a high degree, versatile in its habits, adaptable to all conditions, it is an animal of considerable economic importance.

The prevailing idea is that there are two distinct species in this region but after lengthy observation I am inclined to recognize but one. This is *Neotoma fuscipes annectens*. Its varied activities have brought into common use the names "bushrat" and "traderat." The destructive activities are attributed to the bush or woodrat. The name traderat comes from the habit of replacing stolen articles with others, such as sticks, stones, dry bones, or pieces of dry cow manure. Variations in environment may account for these diverse habits but there is no apparent difference in the animals.

In the woods on all sides will be seen the nests of these rodents. Beyond recognition of the nests as the homes of the animals very little seems to be known of the inhabitants themselves. They are very shy and are seldom seen in daylight. On rare occasions one may be driven from a nest or seen wandering aimlessly in the trees during the day, but the activities are mainly nocturnal.

Several years ago in a camp in the mountains these animals became a source of annoyance. This camp was made in a steep little side canyon away from the travelled road and under some spreading live oaks. On the adjacent hills was a dense forest of mixed oaks, together with some madrone, redwood, laurel and the usual poison oak and hazel underbrush. The camp soon became the recipient of all kinds of attention, most of it very undesirable, from the rodents.

In the immediate vicinity of the camp there did not appear to be any of the nests of these animals. Within a few days however many articles of food began to disappear. Potatoes and pieces of bread vanished overnight. Very soon the entire supply of potatoes was gone. Then other things went. One evening a large piece of cold boiled meat was taken. Another night a large roll of jelly cake was taken.

I returned to my camp after an evening's absence just in time to see the roll of cake going under the rear flap of the tent. It had been rolled, pushed and dragged about considerably but showed few teeth marks. Several rats participated in this raid.

The so-called traderats carry away many very unweildy things, often to points high up in trees where nests have been made. They have a fondness for dried prunes, crackers, bits of glass, bright metal and sometimes pieces of brightly colored cloth and will carry such things to the nests for storage. In exchange they leave a chip, a small stone or anything that may happen to be handy and such things were frequently left in place of my bread and potatoes.

I have a record of a nest built at a considerable height in a pine tree that contained the bright inner lid of a lard pail stolen from the camp table, an old fashioned perfume bottle with a little mirror on one side, and many musty prunes and crackers. The perfume bottle contained gun oil and was rescued without the contents having been spilled. I have seen many other dexterous performances by these animals.

I watched many days with a little rifle handy to destroy my visitors before seeing one of them. In the meantime I went in search of the nests and found a colony established in a dense thicket of hazel brush in an almost impenetrable side gulch three hundred yards from camp. In this thicket were a dozen large conical nests of the type most commonly seen. These were built in such a way as to receive considerable support from the large stalks of the hazel which was very rank in growth. These piles of dry sticks were like so much tinder so I fired them, the surrounding vegetation being wet and green enough to prevent fire from spreading. Fire was applied at the top and burned rapidly downward. As they were fired one at a time I watched for the fleeing rats but saw none. The occupants took to underground passages and later came forth and proceeded to rebuild. In a few days the nests were well under way and assuming good size. Had a general fire run through the brush they would have deserted the locality for an unburned site. I have recently (1919-20) witnessed extensive burnings of brushy areas to rid a neighborhood of rats and within a month many new nests were in process of construction a very short distance from the burned area.

One morning while at an early breakfast under the trees at my camp I noted considerable commotion in the branches overhead. A half dozen small animals were running back and forth at play, unconscious of or unconcerned at my presence. I did not attempt to destroy them at this time and in several days they became quite tame showing

no fear of any one around the camp. They appeared regularly morning and evening and quite frequently came down to the ground for bits of food.

To me they appeared quite stupid and rather sluggish in movement. They did not move with any great speed and such of them as I have seen at distances from the nests did not take alarm very easily. It may be that their great curiosity overcomes fear to a certain degree.

Eventually these little visitors became such a nuisance that the rifle was brought into use. Sitting at my table I shot six of them as they sat in the branches of the tree above me. They made no effort to get away, simply squealing a little at the noise but otherwise appearing unafraid. They presented a ludicrous and helpless appearance.

They were all apparently dwellers in a nest located in a large oak at some little distance from the camp. I could trace their course of travel through the trees from that vicinity. I have since seen regular courses travelled by rats through the madrone thickets, regular paths being worn in the tender young green bark early in the fall. These six rats were of an even size and were always seen together and I have thought they were all of one litter. They were four to five inches long with a tail a trifle longer than the body. The fur was of fine texture and condition although it was the middle of May. It was clean, soft gray on the sides and back and pure clean white on the belly. The head was short and rather heavy in appearance with a blunt nose and short, rounded, erect ears. They had the look of rats approaching maturity.

I have since found stray animals about a third larger than those mentioned. These latter were probably old as they had dirty gray fur and a more rat-like appearance. On the ground they were slow of movement but were much speedier in the trees. Aloft in the trees they were not inclined to run far or escape when observed. They would stretch their bodies lengthwise along a limb without much attempt at concealment and then follow every movement of a person on the ground with their eyes. Unlike the squirrels they do not seek to keep the tree between themselves and an observer. When shot at with a rifle they would sit up on their haunches and squeal but make no attempt to run away.

On occasion I have disturbed rats and forced them into the trees where I have thrown sticks at them with the intention of making them move rather than to injure them. If the missile passed close enough the rat would move a short distance and wait for another missile to be thrown. The result almost invariably was that the rat would travel

in a circle that kept it in close touch with the nest. If the nest was destroyed the rat could then be driven away immediately, usually to a small refuge nest high up in the trees.

NESTS

The dwelling of this woodrat and the methods used in its building are of much interest, even though these nests appear to the casual observer to be nothing more than piles of dry sticks and trash. The animals are versatile in their adaptability to their surroundings, in the methods of construction, and in the utilization of materials; and are exceedingly dextrous in the handling of large and unweildy objects.

Before going into details of the structure it is necessary to know something of the requirements of the animals. They appear to be sociable by nature. In one case I found evidence of two families occupying one large nest. Frequently hard and well worn paths will be found leading from one nest to another, indicating intercourse between them. Usually the nests are to be found in colonies, isolated nests being exceptions.

In certain localities where I have collected botanical specimens the nests are built in every thicket, against trees and around stumps, and in the branches of the trees, in fact in every conceivable place that affords the needed support and protection. The methods of utilizing these facilities are often unique and ingenious. The preferred places are in the dense forest but sometimes the nests are built on open rocky ledges. In the latter case they are solitary and small.

Conditions to be met in the selection of sites for individual nests and for colonies are the sources and abundance of food supply, the general safety and security of the nests, and the ease in securing the needed building materials. Proximity to water is not essential and the animals often travel considerable distances to it. The presence of humans is not taken into consideration, although they delight in raiding habitations and belongings.

I have on occasion come upon rats beginning the construction of a nest. One pair began at the base of an oak and made an excavation on the downhill side that ran back at an angle a foot in the hard, finely pulverized, rocky soil and was so placed as to receive the greatest amount of protection from the base of the tree. They next gathered a large number of small twigs, most of them freshly cut, which they piled in such a way around the opening as to form a chamber above it. This fine material they then covered with larger and coarser material

until they had a considerable pile of sticks. Into this upper mass they wove many long, green boughs of freshly cut laurel and vines of different kinds with some long sword ferns and filled the interstices with dry cow manure brought from an adjacent pasture. In the course of several weeks this nest became a structure of considerable size and strength.

Apparently this mass was piled more or less aimlessly around the base of the tree but the effect was to bind the nest securely together. The entrance, as in many others, was at the base on the lower or downhill side. The amount of debris that accumulated around the base of this nest seemed to indicate considerable extension of the original cavity and the running of some small lateral tunnels.

The material used in these buildings is subject to rapid decay. Most of the woods used are soft and light and yield readily to the gnawing of the rodents. When manure, vines, and ferns are used the process of decay is accelerated. This decay necessitates a constant renewal. At the edge of a forest I have found nests that were built around fallen oak logs and stumps and the material used in the construction was such that little renewal was required. In the fall months all nests are gone over to some extent. This work begins at the approach of wet weather and frequently continues until the long dry season sets in. During the summer season there is a general appearance of dilapidation.

A nest on the edge of the forest will show some signs of freshening up and a considerable amount of debris will be removed from the interior, while nests in the dense forest will frequently be buried under masses of manzanita and toyon. Neither wet nor cold seems to influence the amount of this rebuilding. In the spring there is a season of cleaning house and large amounts of filth, dirt, droppings, and decomposed material is dumped in heaps around the entrances. The nests are again covered with long laurel withes or branches clipped from redwood or manzanita and vines like the wild cucumber and with ferns.

A large house is not necessarily an indication of a large community occupying the nest. Size is attained by the constant addition of material required for the protection of the nest and its occupants. There is very little evidence in many of the nests which have been dismantled, to show that the upper portions of the structure are used for any purpose at all and only in a very few have any open chambers been found above the main quarters. Where these chambers have been found there is nothing to indicate the purpose for which they were made. The breeding nests are in the lower chambers close to the under-

ground passages and there is an absence of filth around them. The living quarters are generally filthy.

The larger a nest becomes the greater is the amount of work required to maintain it. Its length of life extends over a number of years of slow growth followed by a comparatively rapid decay when the forces of nature have become too great to overcome. In wet weather the nests absorb a large amount of moisture which is held for a long period and adds very materially to the rapidity of the decay. Then there comes the long, dry, desiccating summer weather when the soft materials crumble to dust.

The rats are not satisfied with the underground retreats for they build small refuge nests high up in the trees in the vicinity of the ground nest. When driven from the safety of the latter they will take to the trees and finally seek the shelter of the tree nests. A sudden sharp blow upon the ground nest will frequently scare a rat into the trees and on rare occasions one will go directly to the tree nest. More often the rat will remain in the vicinity of the main nest until compelled by force to leave it. If a person begins to dismantle a nest at the top the rats will seek the underground passages and none will be seen on the surface. I have succeeded in driving out one rat but have not been able to get sight of a second in any nest.

I once dismantled a nest that had reached its maximum development in an exceptionally favorable location. One side of a huge redwood stump had been burned in a fire and then broken off leaving a stub on one side while the fire continued to eat its way down the other into the roots. The side exposed to the heavy weather remained standing and the inner portion of it formed the bracing side for the nest. Against this upstanding slab there was piled an enormous amount of trash.

Beginning carefully at the top I removed a considerable pile of coarse sticks and rubbish, finding only a few small open chambers. When I had reduced the pile by fully three-quarters of its original bulk I came to a large chamber. This chamber was larger than usual but had not been cleaned out at the end of the rainy season and was very filthy. In one corner there was a small nest such as some bird might build. This nest was carefully woven of fine long grass and wood chewed into a resemblance to excelsior. The center was perfectly hollowed out and lined with soft fur. It was some five inches in diameter and four inches deep. This nest had been recently occupied and the young I think had been removed to some underground passage.

There was an entrance to an underground passage on the opposite side of the chamber to this breeding nest. This underground passage was an old burnt out root about ten inches in diameter and four or five feet below the level of the ground and extended laterally to a river bank some few feet distant. I ascertained this by starting a smudge. I forced some smoke into the hole and drove a rat out into the open on the bank. This nest was not rebuilt.

Unusual forms of construction are frequently met with and are often a puzzle. I found several along the rocky ledges at the Guadalupe Mines which were but little more than heaps of sticks piled around deep holes or crevices in the rocks, the material in which must have been secured with difficulty. I endeavored to interview the occupants of one such nest with some unexpected success. One of the occupants was a very long slender snake, probably a California striped racer, which proceeded to race back and forth through some brush but I could not make it leave the vicinity of the nest. It is said that rattlers sometimes use these nests but although I have had some painful experiences in trying to prove it I have never found the rattler in the nest. If the rattler occupies the nest he also eats the rats.

I have observed many strange nests this last season or two, but none of them illustrates the ingenuity and dexterity of these animals more than one which was found on the site of an abandoned farm near Los Gatos. The nest was built in the crotch of an ancient laurel which had partly decayed as these trees frequently do. The usual brush and rubbish was piled loosely around on the ground. Above this was an immense pile of shingles built into the crotch of the tree to a height of five feet or more, all laid flat one upon another and securely braced to prevent falling. These rats had carried shingles a hundred feet or more from an old fallen roof and piled them with an infinite amount of labor.

In the Guadalupe Mine region where there are some very large coast live oaks (*Quercus agrifolia*) the rats have taken advantage of heavy crossing branches in a unique way. Two nests were located close together in adjacent trees where the outer limbs crossed and braced each other and formed a solid base to build upon. The builders used three crossing limbs as the foundation and then drew in the smaller branches as the nests grew until the whole nest had attained a height of five feet or more and the base an area of nine or ten square feet. Although these nests swayed back and forth with the heavy winds they were very solid and difficult to take apart. These nests were two

seasons in the building. Each contained a large central chamber. In each nest I found a single old rat and signs that young had been in the nests recently. One of the curious features of these nests was the amount of dry manure used in the construction. Fully one-third of their bulk was made up of this material brought from an adjacent pasture.

FOOD AND FEEDING HABITS

There is plenty of evidence that the woodrat is a gross and destructive feeder. The animals are wanton in their ravages, destroying great quantities of things for which they have no use. It seems to be their special delight to enter cabins and ranch houses or other buildings and chew up papers, books, clothing, and whatever else they may find and such debris is left in heaps wherever it has been destroyed.

I have never seen papers or kindred articles in the nests or signs that they have been taken any great distance from dwellings. Bits of bright cloth like other bright things may be carried to some distance. At the cabin of a friend the food supplies were regularly raided and the salt and soap seemed to be favorite articles. One spring my friend missed some silk socks and a bright necktie. In the fall we found both in remnants together with some soap in a nest a quarter of a mile away. The rats seemed to develop a streak of mischief with a bit of humor and persistence in it. Every night the woodbox in the cook shack was a center of attention. This building being more or less open the rats had easy access at night. In the morning the wood was to be found on the floor, the pieces being laid out in rows and placed neatly end to end. This was repeated many times.

The season of 1919 produced an abundance of wild berries and fruits. The madrone trees bore enormous crops of the bright red berries which are known as the favorite food of the robins and wild pigeons of this region. In the vicinity of my friend's cabin the madrones are very abundant and the woodrats are also present in very large numbers. When we were opening some of the nests in search of young we found great numbers of madrone berries, which had been cut from the trees in clusters and taken to the nests as needed. This fruit must have been used to feed the young since the old rats eat what they require where it grows. It is a significant fact that the berries were placed conveniently near the little breeding nests that had contained young very recently. The berries are not eaten for the pulp that surrounds the large seeds but in the nests they are cracked open and the kernel is eaten as we would eat a nut.

No permanent food supply seems to be laid up regularly for winter use as is the case with the northern rodents. The climate is such that there is a constant supply of food of some kind available the year round. The conclusion is that when food is found in the nest it is there for the feeding of the young. During many months of the year when there are acorns to be found the rats are industrious in gathering them for food, but they are in the greater number of cases consumed where found. On two occasions in the fall of 1919 when examining nests I found acorns of live oaks stored for use directly in front of the breeding nests. The little nests had contained young within a short time of my visit and fragments of freshly eaten acorns seemed to indicate that the young had eaten of them within an hour of my opening the nests. In these piles I counted over five hundred acorns without taking more than half of them.

In one nest after removing the acorns I found a peculiar arrangement of the underground passage in which the young probably took refuge. The central chamber was quite large, the breeding nest was at one side with a passage beside it, and the acorns were piled on the opposite side with a mat made of the fine, long, tough twigs of a species of wild cherry beneath them. The main passage way passed directly beneath this mat and furnished the rats access to the pile of acorns without coming to the main chamber.

Fungi form one of the most important foods of the rodents here, if not the most important. One variety or another is to be found through a very long season if the rains are sufficient. It is in those winters when the rainfall is light that the rats make the greatest use of acorns and other foods. The botanical field work that I am doing relates to the groups of fungi which grow under the surface of the ground or are buried under the leaves of the forest, and are practically unknown in this country to any but a few scientists.

The collector of this kind of fungi in America is handicapped to a very great extent as he must choose his working place at random or by instinct. In Europe where truffles as well as others of this class are abundant, the fungi are strongly aromatic and certain animals are trained to search for the hidden plants. Unfortunately, while truffles in California are abundant, they are not in any sense aromatic. The plants give no evidence of their presence and must be located by some other means than by smell. We have another group of plants which may be called false truffles (i.e. *Hymenogasterales*), since they grow after the manner of the real truffles and some of the many species

are exceedingly aromatic. It is this latter group which is closely associated with the woodrats. To the woodrats or to the signs they leave, credit is due for many important discoveries. These signs and the reading of them are most important to the collector who desires to secure specimens of this kind.

There is a district within easy reach of San Jose which I visit frequently in following up the life cycle of the various species of fungi. This is the region of the New Almaden Mines and the Guadalupe Mines. The rats are or have been assembled there literally by the thousands. It is a region well favored with all kinds of fungi. It is wooded densely with a second growth of liveoak interspersed with the usual underbrush of manzanita, *Baccharis* and poison oak. The soil is largely pulverized rock and quartz. For a long time I got very poor results in the collecting of fungi but occasionally I found large specimens of the Agaricaceæ and Boletaceæ which had been partly consumed by some small animals. At the same time my attention was frequently called to many excavations in the leaves and hard soil. These excavations were very puzzling but I had in mind the fact that some animals fed on truffles in Europe and that there might be a similar occurrence here.

The mystery of these holes in the ground induced me to return many times to this region long after it seemed that search for the truffles was useless. Persistence in following up these signs led to the finding and developing a district wonderfully rich in these strange forms of fungi. Months were spent in learning the meaning of these signs and excavations made by rodents but now they are read with as much certainty as a printed page. The form of the excavation often serves to identify the various genera of fungi present. But it is important to note that these signs do not reveal all that is underground. The woodrat is the mushroom hunter par excellence.

Late in March of 1917 I was in the Guadalupe Mine region following up some discoveries of a few days before. I became involved in a dense thicket of manzanita where progress was made only on hands and knees. I shortly brought up before a rat's nest of large size and disturbed a rat working in a hole at the base. Examination revealed several other holes in process of excavation and one large hole about four inches in diameter at the top and nearly a foot deep. At the bottom of this hole was a large fungus, strongly but not unpleasantly aromatic, which was partly eaten.

I completed excavation of the other holes and secured seven fine specimens of this fungus, all strongly aromatic. I assumed that these plants were desirable for food for the rats and associated the many excavations which I had been finding with the work of the woodrats. I also assumed that there must be some relationship between the location of nests and the location of desirable fungi. The conclusion arrived at after considerable study, was that where the woodrats were numerous the fungi must likewise be abundant. This is well borne out by subsequent discoveries. This particular fungus, genus *Gautieria*, I have never found at any great distance from rat nests. The plants of this genus are, in this locality, rarely found less than six inches and frequently nearly a foot below the surface. They are seldom found in any but very dry ground which is firmly packed. This condition requires a great amount of digging. When a mature fungus is located by a woodrat a hole is excavated until the plant is visible. It is then eaten in the hole. I have found many of them partly eaten in the holes but have never seen one removed from the hole. It is some feat for the rat to stand upon its head and consume such an article of food.

The genus *Gautieria* is found in abundance in normal moist seasons in this region from November to July. It is perhaps the most powerfully aromatic of all the species without being so foul as some are; beyond doubt it is one of the most esteemed of all the fungi and forms one of the most important foods for the woodrat.

In one place the rats opened up a series of holes around the sides of a steep, wooded ridge very much as a miner would sink test shafts in developing a vein of ore. In this way they followed for considerable distances parallel veins of mycelium, opening up holes at intervals of two or three feet and consuming the matured fungus at the bottom of each. By opening up the exposed veins between these holes a large number of plants were collected in their immature stages and which had not yet developed an odor. The woodrats seem to ignore the plants that have not yet developed to this state of maturity. It is solely by the sense of smell that the plants are found. I have seen other plants cast aside in the excavations because they lacked an odor.

There are several other species scattered through these hills in more or less abundance which have not been described scientifically and which form a very considerable item in the food supply of the rodents. These are all strong-odored varieties. They are all more or less buried in the soil and humus and are to be found by digging in appropriate places. Some are found among the leaves, others beneath the leaves

but on the surface of the soil, and still others at various depths beneath the surface. Occasionally they are found uncovered on the surface of bare soil but always beneath various trees.

One of these plants of somewhat common occurrence (genus *Melanogaster*) possesses an exceedingly powerful, spreading odor and is to be found growing among the leaves. It has the appearance of a small puffball of a reddish or brownish color. The rats range far and wide for these plants during the season and when they find them they turn over the leaves and humus sifting it into a fine mulch in their efforts to secure the fungus. These, as in the previous cases, are eaten on the spot. Being of the consistency of a rubber ball they make a rather tough bite. In spite of the very strong odor, the plants are, to the human taste, rather sweet and pleasant.

Some of the species serving the purpose of food for the rats are very malodorous, others somewhat pleasant. There are two species widely divergent in size, appearance and genera (*Hymenogaster* and *Hydnangium*) which have the same relative odor resembling that of witch hazel. Both are much sought after in season.

One of the remarkable facts established is that in each genus there is one species which stands out from the others in this matter of odor. It might be said that there is one species which represents the type of the genus because of its marked characteristic odor. This one species seems to be the most abundant one of the genus. The other species seem to have this character modified until the odor becomes almost negligible. Correspondingly their use by the rats decreases.

There is one fungus (genus *Hysterangium*) which seems to stand above all others in some respects in its relation to the rats and I might add, to the person collecting it. It is in appearance like a little white puffball with a tough rubbery gleba usually of a green color. Its predominant character is its exceedingly vile odor when mature. It is almost impossible to carry the plants in a collection, so offensive is this odor. Its habitat is among the leaves or slightly buried in the ground where it is easily accessible to the rodents. Where it is to be found the rats will pass by all other fungi to get it. I have seen the fragments of the white peridium scattered over considerable areas of the forest and excavations are to be found everywhere. The peridium seems to be rejected for the tough gristly interior portion. It is frequently to be noticed that many young plants are left, the rats taking only those which have fully matured.

At Guadaloupe Mines I found an exceptional location where the humus beneath the oaks had accumulated to a depth of a foot or more.

In this bed of leaves were signs of rat excavations showing the trend of a vein of mycelium of this offensive fungus. I uncovered a considerable area and secured some specimens. Along this vein I opened up another vein of mycelium belonging to another species of the same genus. This latter species is very different from the offensive one, particularly in the matter of odor. This odorless species was rejected. To the human taste there is no perceptible difference. This latter plant is larger and more attractive but not so common. Enlarging the excavation to the base of a very large rat nest I encountered still another genus (*Octaviania*) with a number of fine large plants. These were all mature but not odorous and some of them lay alongside of the offensive species. Many of them had been uncovered by the rats but all were ignored.

In many of these excavations I have found many different species of the real truffles but only once have I found one that appeared to have been eaten by a rodent and this I think had been bitten by a gopher. The truffles are all very finely flavored but apparently few of them have any perceptible odor which I think is the cause of their rejection for food. I have found in several places however a species in a genus very closely related to the truffles which has a very strong odor and was much sought for by the rats. This one (genus *Elaphomyces*) is abundant in the center of a large rat colony in the vicinity of Saratoga. In excavating for this species the rats opened up a trench exposing the mycelium for several feet at a time. This mycelium is found at a depth of four to six inches and the fungus is imbedded all through it.

In time of scarcity in the winter when a cold snap has destroyed most of the fungi the rats are frequently put to it very hard to secure the necessary food supplies. At such times they resort to the remnants of common fungi remaining above ground. Wanting these they go to extremes to satisfy their appetites. I have found half gnawed buck-eyes, large galls from certain oaks, and other things within the nests. Twice this last season (1921) have I seen the thick bark of live oaks girdled by rats. They are persistent in their search for newly sprouted acorns.

All of the fungi mentioned are to be found in the collections filed in the Herbarium of the Department of Botany of the University of California at Berkeley. Acknowledgments are due to Dr. W. A. Setchell of the Department of Botany and to Mr. Tracy I. Storer of the Museum of Vertebrate Zoölogy who have been more than helpful in the preparation of this paper and in many other ways.

Berkeley, California.

DR. JOEL ASAPH ALLEN—AN APPRECIATION¹

BY E. W. NELSON

[Plates 13-14]

With the passing of Dr. Joel Asaph Allen modern American science lost one of its foremost pioneer leaders. It was my privilege to know him for a period of more than 45 years. First when as a boy interested in birds in northern Illinois I secured there the first specimens of a sharp-tailed sparrow. Doctor Allen learned of this and at his request they were forwarded for his examination, with the result that he described the bird as a geographic form previously unknown to science. This was followed by his kindly encouragement and a personal interest in securing the publication of several of my first papers on birds, thus supplying some of the final factors which resulted in my decision to follow a scientific career. I believe that many other beginners were similarly helped through his direct intervention.

From the time of our early communications I regarded him as a personal friend, and in later years when we came into more direct contact we passed many enjoyable hours together, both in his office and while I was a guest in his home. In social intercourse his quiet geniality made him a delightful companion. The persistence of his work did not rob him of the power of seeing the humorous side of things nor of a quiet but lively appreciation of fun.

Another little-known phase of his experiences and character was uncovered when after knowing him for many years I accidentally learned that in the early days he had personally made large collections of big game in the West for the museum at Cambridge and that he had been more than an average good shot with a rifle; those collections including bison, elk, deer, antelope, and mountain sheep, with numerous smaller species. During one of my visits at his home I brought up the matter of these experiences and was deeply interested as he described many of the episodes in securing these specimens. His sparkling eyes and unusual animation showed that under his quiet demeanor he must have possessed much youthful enthusiasm.

Comparatively few men living now can appreciate the difficulties that beset the path of the young naturalist in the days when Doctor

¹ Presented at the dedication of the North American Mammal Hall in the American Museum of Natural History, to the memory of Doctor Allen, during the fourth annual meeting of the Society in New York, May 18, 1922.

Allen began his work. The contrast between the conditions confronting the embryo naturalist then with the easy road of scientific research today may be likened in a material way with that between an old stage coach traversing a rough country road and the modern automobile on its cement highway.

In the early days of his career, from 1850 to the early seventies, fellow naturalists as well as scientific publications, scientific libraries, and collections, were exceedingly rare, and the young student in any branch of natural science was looked upon as following a pursuit of no importance or value to the community. Under such handicaps persistence in making natural science a life work meant the devotion of an enthusiast. We might paraphrase an old saying by stating that "A naturalist is born, not made," with full force in its application to a man like Doctor Allen, who at the age of 13 was irresistibly drawn to the path which he followed to the end of his life.

He was fortunate in having been born in eastern Massachusetts, where he eventually became one of that small group of men who studied under Agassiz and who afterwards became notable leaders in their various branches of science. He was also fortunate in having an opportunity as a young man to do field work under such varied conditions as those presented in New England, Brazil, Florida, the Mississippi Valley, and some of the Rocky Mountain States. This field experience was invaluable to him subsequently during his many continuous years of laboratory work. It broadened his knowledge of birds and mammals in life and their relationships to their environment, giving him a fund of invaluable facts which were most useful in his philosophical consideration of problems of evolution and of distribution.

Doctor Allen had a philosophical mind which looked into the meaning of the facts of Nature, and his ideas concerning evolution and the distribution of life in faunal areas were set forth in numerous papers. One of the earliest and most notable of these was his "Mammals and Winter Birds of East Florida." His writings exerted a marked influence among American naturalists in directing their attention to fascinating fields of investigation of broader scope than that of identifying species and recording technical characters.

He was one of the leaders in organizing the Nuttall Ornithological Club, at Cambridge, and later was one of the three men who issued the call to organize the American Ornithologists' Union, which was the child of the Nuttall Club. Through the enthusiasm aroused by this organization American ornithology developed with extraordinary

rapidity and active research was instituted in a number of problems, in all of which Doctor Allen took a leading part. The work of the committee of the Ornithologists' Union on the conservation of bird life grew into such importance that it resulted in the birth of the National Association of Audubon Societies, of which Doctor Allen was one of the five organizers and in which he was an active director to the end. Among the other conservation work in which he took a prominent part was the formulation of the American Ornithologists' Union model bird law, which has been the foundation of much of the subsequent bird and game legislation in this country. This has been of incalculable value in conserving many forms of our wild life from extermination and was one of the elements leading to a practical activity in the conservation of wild life in the United States which is equaled nowhere else in the world.

Another committee of the Ornithologists' Union in which Doctor Allen took a part, that on the distribution and migration of North American birds, also outgrew the committee stage and became a division of the Department of Agriculture, later developing under the leadership of Dr. C. Hart Merriam into the Bureau of Biological Survey.

At the time the American Ornithologists' Union was organized zoölogical nomenclature was in a chaotic condition, which greatly increased the difficulties of scientific research. A committee on nomenclature was organized in which Doctor Allen's knowledge, clearness of vision and powers of logical reasoning made him a leading figure. This committee prepared the American Ornithologists' Union code of zoölogical nomenclature, which later became the basis of an international code, thus exerting world-wide influence on this phase of scientific research.

The early years of Doctor Allen's career were passed at what was then termed the Agassiz Museum but is now known as the Museum of Comparative Zoölogy, at Cambridge. In 1885 he became curator of birds and mammals in the American Museum of Natural History, where he had greater opportunities and his influence in the development of scientific research increased. For many years his attention had been devoted mainly to the study of birds, but during the last half of his life most of his time was given to mammals, in which he did notable work and held the same leadership that he had attained in ornithology.

At the time he came to the American Museum this new institution had practically no scientific study collections. Throughout the rest of his life he promoted many scientific expeditions to all parts of the world, and in addition encouraged the purchase of material, until the

study collections of the Museum today are among the most notable in the world, containing more than 200,000 specimens of birds and mammals, and with the great collections in other branches of biology give this institution high rank as one of the increasingly great centers of scientific research.

One of the greatest and most unselfish of the many services done for American science by Doctor Allen was his editorship first of the *Nuttall Bulletin* and then of *The Auk*, the journal of the American Ornithologists' Union, which he continued for a period of 35 years. This editorship was notable for the painstaking character of the work, especially in the innumerable reviews of ornithological publications, which had much influence in encouraging and developing young ornithologists and in promoting the increase of ornithological research. In addition, he also served for many years as editor of the *Bulletin* and other publications of the American Museum, placing them on the high plane which they have always maintained.

Doctor Allen continued throughout his life to devote the major part of his time to scientific research in birds and mammals, the extent and variety of which are shown by a bibliography almost unequalled in length by that of any other American scientist. Among these were several magnificent monographs, of which special mention may be made of those on "The American Bisons," "The History of North American Pinnipeds," and that on the musk oxen, which were masterly contributions to knowledge.

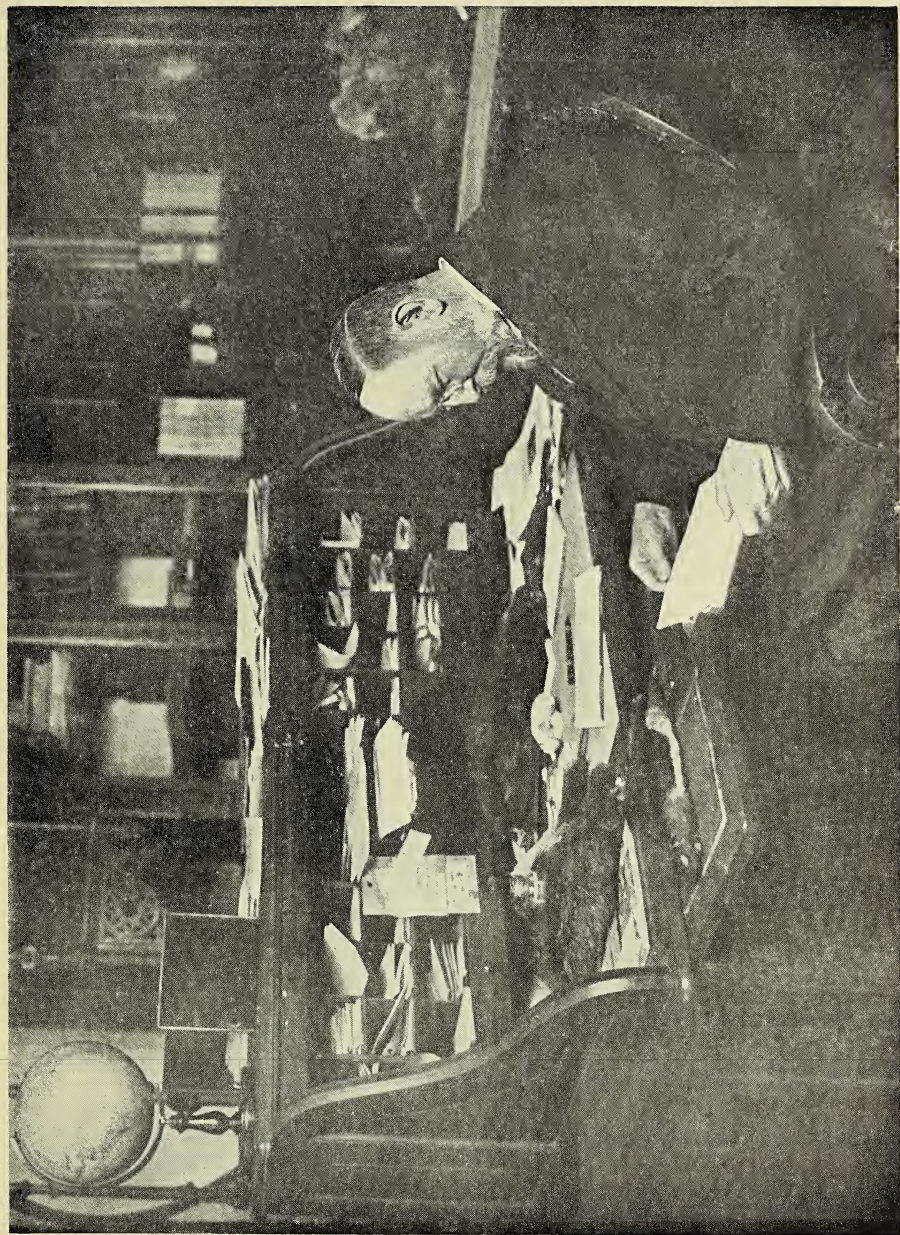
The early influence of Doctor Allen, and the small group of contemporary leaders with him, developed an appreciation of the meaning of geographic variation and its effect on the fauna and faunal relationship beyond anything of the kind previously known. Eventually the influence of this work spread and has profoundly affected the methods of scientific study of zoölogy both in America and in other parts of the world.

No account of Doctor Allen's career should omit reference to the extraordinary persistence and industry which continued throughout his life. He had a frail physique and suffered the serious handicap of more or less persistent ill health, and at intervals had physical breakdowns which threatened to end his career. He had within, however, the marvelous fire of a great spirit which ignored weakness of the flesh and steadfastly carried on his work under conditions which to many would have appeared impossible. He early learned to conserve his strength and for many years devoted himself steadily to office and

laboratory work, living an exceedingly simple life with almost no exercise beyond that had in his daily trips to and from his office. His friends often marveled at his being able to maintain himself in working condition under this routine, particularly when it was known that he was keeping persistently at his task of editing and writing, not only during office hours but evenings and Sundays, taking little or no recreation and pursuing this course year after year. Even then the extraordinary amount of his scientific output was made possible only by his ability to prepare his manuscript practically ready for publication in the first draft, the years of training in writing reviews and doing other editorial work undoubtedly having developed this most enviable facility.

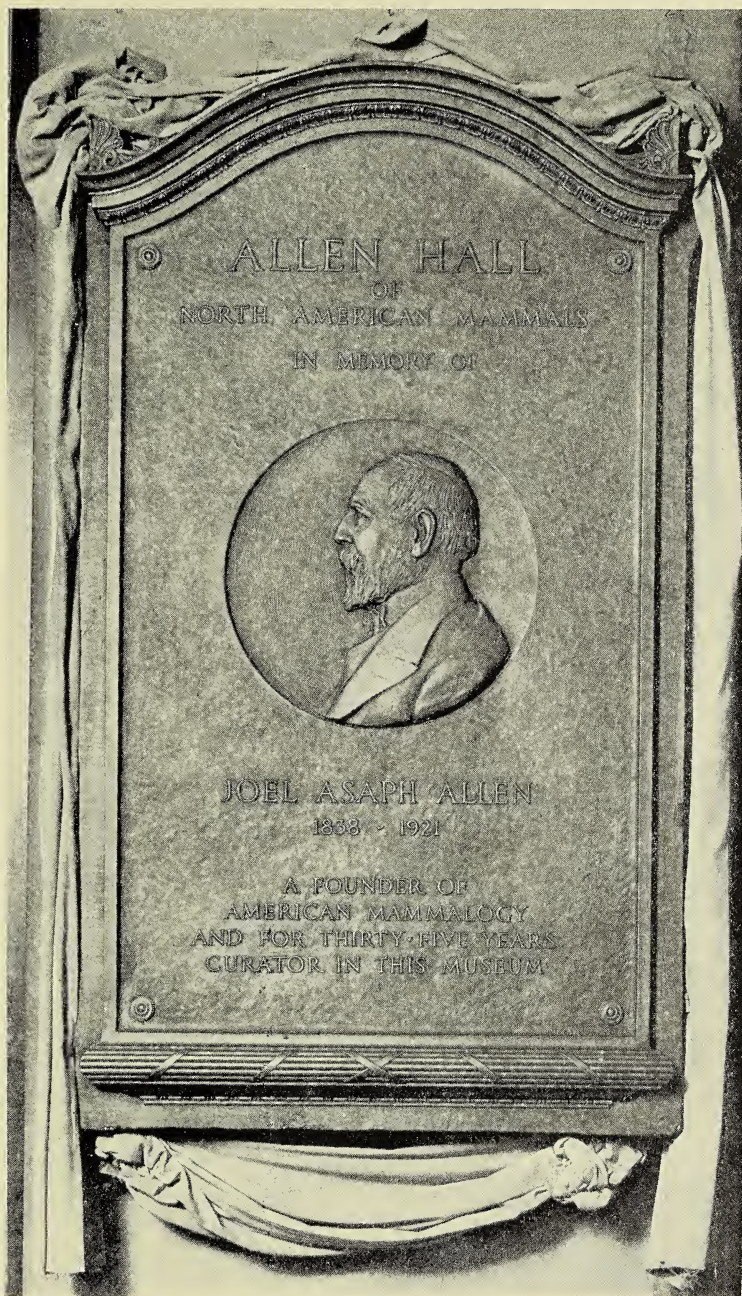
For many years Doctor Allen's career served as a great stimulus to young naturalists throughout the country. His clearness of insight and mental powers were backed with a strong will, which quickly impressed all who came in close contact with him. Among American scientific men few have been held in such general esteem and have been able to so influence their contemporaries and the development of the sciences in which they worked. His loss will long be felt not only among those who had the privilege of knowing him personally but by many workers who paid him the tribute of admiration and respect as a great scientific leader.

Biological Survey, Washington, D. C.



JOEL ASAPH ALLEN, 1838-1921
Courtesy of American Museum of Natural History

(Nelson: Dr. Joel Asaph Allen.)



MEMORIAL TABLET AT ENTRANCE TO ALLEN HALL OF NORTH AMERICAN MAMMALS

Unveiled at Fourth Annual Meeting of the American Society of Mammalogists, May 18, 1922. Courtesy of American Museum of Natural History.

(Nelson: Dr. Joel Asaph Allen.)

GENERAL NOTES

SOME RANDOM NOTES ON MAMMALS OF MINNESOTA

Lutreola vison. Mink.—In the fall of 1920, a farmer living on the Jefferson Highway between Elk River and Big Lake, Sherburne County, found a mink on this road that had evidently been killed by an auto. This was on a cement paved road.

Mephitis sp. Skunk.—There seems to be more or less disagreement as to the skunk's ability to discharge its scent under difficulty. I have taken and helped to take about fifty skunks from their dens in the last seven years. All were taken out alive and about one-half without their discharging any scent. There seems to be one, and only one, way to handle them safely; that is, grasp both hind feet and the tail firmly in one hand and pull them from the hole until the head appears, then grasp them around the neck. As long as they are held in this manner they cannot discharge scent, if the hind legs and tail are held straight out behind and a steady pull is maintained to prevent the back from "humping." They may then be placed in a sack and carried in the hand with the sack hanging free. Do not let them touch the ground or bump them. I have never had one try to bite, but would not take any chance, as I have known of their biting, and the bite is no joke.

Marmota monax rufescens. Woodchuck.—It seems to be not generally known that woodchucks climb trees. This was quite a surprise to me as I never considered this worthy of making notes on. The only time that I can give any definite information on is as follows: In the summer of 1917, while building fence, I saw a woodchuck fifty feet up in a basswood tree. I remember this because I threw my hammer at it and the hammer lodged in a crotch of a limb on which the "chuck" was sitting and I had to climb the tree to get it.—BERNARD BAILEY, *Elk River, Minnesota*.

TREE-CLIMBING WOODCHUCKS

Mr. Harold St. John's article in the *Journal of Mammalogy* for November, on the tree-climbing woodchuck, came to me very much in the nature of a surprise. Years ago, as a boy, in Ontario County, New York, I repeatedly saw woodchucks "treed" by dogs, not infrequently to a height of at least ten feet, usually on the trunk of a tree of small diameter. Others with whom I used to discuss such experiences spoke of them as more or less commonplace. I had, therefore, assumed that while woodchucks were not arboreal by preference, they readily took refuge in small trees, when surprised at some distance from burrow or rock pile.—B. S. BOWDISH, *Demarest, N. J.*

THE SUBSPECIES OF WOODCHUCK IN VERMONT

In connection with an article by Harold St. John in the November, 1921, issue of the *Journal of Mammalogy*, there is pictured a woodchuck, photographed as it was climbing a tree, and under it is the name *Marmota monax preblorum*. The photograph was taken at Hartland, Vermont. Possibly this name was used because the subspecies of woodchuck mentioned is assigned to central Vermont

by A. H. Howell in his monograph, "Review of American Marmots," North American Fauna, No. 37, 1915.

A short time after the marmot "Fauna" appeared, I collected a number of woodchucks in Vermont and sent skins and skulls to Mr. Howell, who kindly examined them. He pronounced them all (seven, if I remember rightly) *Marmota monax rufescens* and remarked that some further revision of New England woodchucks would be necessary. In his review he writes that material from northern New England is lacking. The specimens sent Mr. Howell were from Rutland, from Ferrisburg, in the Champlain Valley, and two from Lunenburg on the east side of the state near the Canada line. There were none from Hartland and immediate vicinity but it is reasonable to suppose that the woodchucks there are the same as in Rutland, 35 miles away.—GEORGE L. KIRK, *Rutland, Vt.*

ANOTHER TREE-CLIMBING WOODCHUCK

The recent article by Mr. Harold St. John in the Journal of Mammalogy (II, No. 4, 1921, 207), concerning "A Tree-climbing Woodchuck" prompts me to relate my own experience with another tree-climbing individual in Iowa.

On July 2, 1914, while doing some field work to which I was assigned by the director of the Iowa Geological Survey three miles northwest of Waukon, Iowa, I disturbed an adult woodchuck (*Marmota monax monax*) which was feeding in an open pasture. Immediately the animal gave a sort of grunt and galloped toward a small white oak a short distance away. On arriving at the tree which was between eight and ten inches in diameter, it did not hesitate at all but climbed, without apparent difficulty, to the first limb which was at least eight feet above the ground. So great was my surprise that I stopped and stared at the woodchuck for a moment, then slowly walked toward the tree. The rodent partly lay across the lowermost limb eyeing me and breathing heavily after its exertion. After watching it for a few minutes, during which time it remained in the same position, I secured a heavy club and dispatched it by breaking its back so that the skull was left intact. The latter is preserved in the University Museum as accession no. 25697.

An examination of the greatly distended stomach revealed only clover, grass, and other vegetation. Unfortunately I did not secure a photograph of the animal. This species is very common in the driftless, hilly area of northeastern Iowa where it does considerable damage and as a consequence of which a vain effort is being made to control it through the bounty system.—DAYTON STONER, *University of Iowa, Iowa City, Iowa.*

WOODCHUCKS CLIMB TREES

Mr. Harold St. John, in the November, 1921, issue of the Journal of Mammalogy relates the case of the woodchuck, *Marmota monax preblorum*, climbing a tree and shows a photograph as evidence. He seems to think that such an occasion is unique and farther states that he had difficulty in convincing people of the fact.

I can assure Mr. St. John that I have frequently seen woodchucks climb trees. Two or three incidents stand out vividly. When a boy on the farm at home I on two occasions stoned woodchucks out of trees where some farm dogs had chased them. As I recall, both of these chucks were small and immature, but a few years

ago I saw a very large one in the top of a black walnut, where it had also taken refuge from the dogs. While such cases may be uncommon, no doubt there are many other observers who have seen woodchucks climb trees.—CLEVELAND P. HICKMAN, *West Virginia University, Morgantown, W. Va.*

MORE TREE-CLIMBING WOODCHUCKS

The note in the November Journal of Mammalogy on a Tree-Climbing Wood-Chuck by Mr. Harold St. John recalls an experience of the past summer. I was engaged in listing the birds of the new Allegany State Park, Cattaraugus County, New York, when one day, July 16, 1921, I came upon a woodchuck (*Marmota monax preblorum*) about ten feet up in a dogwood tree. I had not seen the animal climb there, and do not know whether it climbed there because of my approach or was already there when I approached. The tree was about six inches in diameter, and leaned somewhat to the south which was the downhill side. This tree was in the midst of a large sized patch of woodland, and a considerable distance from any open country. I tossed a few sticks at the animal expecting it to jump or run down the tree, but while it seemed frightened, it seemed also unwilling to leave the tree.

After this experience I asked others who lived in that vicinity the question "Have you ever seen a woodchuck climb a tree?" Almost invariably I got the answer "Yes," with a statement that they often did it to escape enemies. Returning to my home in southern Connecticut I tried the question on people in that vicinity with the answer that they had never heard of such a thing, most of them adding that woodchucks seldom were found near trees. From this experience I concluded that the tree-climbing habit in woodchucks is something that is decidedly local, belonging chiefly to animals that live in wooded regions, rather than to those that live in open country.—ARETAS A. SAUNDERS, *Fairfield, Conn.*

THE TREE-CLIMBING HABITS OF WOODCHUCKS

In the Journal of Mammalogy for November, 1921, there is a photograph and an excellent description of a "Tree-Climbing Woodchuck." I did not know that it was considered unusual for woodchucks to climb trees, but some of my friends think it is.

As a boy and young man, I lived in the hilly region of southwestern Pennsylvania where woodchucks were very common, often becoming a nuisance. I now recall five instances of woodchucks climbing trees. They were all put up by dogs and I observed them in every case. The first live woodchuck that I ever saw was one that a big dog ran up a butternut tree that grew along the border of a woods. The chuck was not full grown, but it went to a height of about 15 feet. My oldest brother climbed the tree and shook it down. A few years later, I was one day walking with my father through a woods containing almost a pure stand of white oak trees. Our dog got between a woodchuck and its burrow and chased it up one of the trees. This oak was nearly two feet in diameter with no branches for nearly 30 feet. The chuck continued to the first stopping place, a large lateral branch or open fork. My father threw two or three stones at it, but failed to hit it. The animal kept looking down at the barking dog and as it did so, it began to shake and wobble and finally tumbled to the ground. This would indicate, to me, that woodchucks are not familiar with high climbing. This one

climbed higher than any other that came under my observation. When grown to manhood, I often went by the tree and estimated the height to which this woodchuck climbed to be at least 30 feet.

Another incident may be of interest. I had gone home from college to spend my vacation with my father. One night about 10 p.m. we heard two dogs in the woods barking as though they had something "treed." My brother and I went to investigate the matter and found the dogs against a steep hillside barking up a dogwood tree. In a fork about eight feet from the ground was a large woodchuck. The dogs had probably treed it sometime during the day and were now laying siege to it. They had the bark peeled from the tree and were doing their best to get the chuck down.

The last time that I saw a woodchuck up a tree was only a few years ago. I had spent the day in the woods collecting plants, and was returning home about sunset. On hearing our dog bark I went to the place and found a half grown woodchuck up a shagbark hickory tree. It was eight or ten feet from the ground and had secured itself back of one of the stiff, shaggy plates of the bark. From all appearances the dog had chased it up the tree sometime earlier in the day.

Where the burrows of woodchucks are along fences, it is quite a common sight to see the animals climbing the posts or rails, perhaps to sun themselves or to make observations. To avoid dogs they will climb trees if they cannot reach their burrows, or escape by some other means.—OLIVER P. MEDSGER, *Arlington, New Jersey*.

CONNECTICUT WOODCHUCK CLIMBS A TREE

In connection with the note on a tree-climbing woodchuck, vol. 2, p. 207, I write to say that my brother, F. C. White, saw a woodchuck climb a tree because frightened by his dog. He subsequently pointed out to me the limb to which the animal had clambered; it was about six feet up from the ground. This was at Hartford, Connecticut.—FRANCIS BEACH WHITE, *Concord, New Hampshire*.

NOTES ON A FEW MAMMALS AT MISSOULA, MONTANA, 1917-1918

Thomomys fuscus fuscus. Pocket gopher.—Mounds are abundant on the bunchgrass of the Bitterroot Valley and over the open slopes of the mountains; a few occur also among the cottonwoods. June 3, 1918, a few minutes past 4 p.m., a half-grown male was found running on the University campus lawn.

Citellus columbianus. Ground-squirrel.—Locally called "gopher." Abundant on the bunchgrass; common in yellow pines; and numerous in the chaparral brush on the mountain sides. In 1918 it was first seen April 10. In 13 adult females taken between May 4 and 16 on the slopes of Mount Sentinel for use in the zoological laboratory, embryos were found as follows: one with 3 embryos 22 mm. in length, as they lay rolled in the fetal membranes; one with 3 embryos 20 mm.; one with 3 embryos 16 mm.; one with 4 embryos 13 mm.; three with 4 embryos each, too small to measure.

Eutamias sp. Chipmunk.—Numerous in cottonwoods, in brush along the canyon streams, in yellow pines, and abundant on talus slopes. In 1917 last seen November 4, and in 1918 first noted April 7. May 19 one was noted eating dandelion seeds while seated on a rock pile at the edge of the cottonwood forest along Rattlesnake Creek. He would cut off a ripe head and then seating himself on a rock would

cut away one side of the head near the base and eat the seeds. He was quite wasteful, spilling many of the seeds on the ground. He apparently attempted to eat only the seeds, but I could not be sure whether or not he cut off the seed plumes, though I think he did.

Sciurus hudsonicus richardsoni. Richardson squirrel.—Few in yellow pines and in mixed yellow pines and Douglas spruces.

Castor canadensis canadensis. Beaver.—April 14, 1918, fresh cuttings were noted on cottonwoods along Rattlesnake Creek.

Lepus bairdii bairdii. Rocky Mountain snowshoe hare.—June 9, 1918, one was seen in Douglas spruce-western larch forest near Lo-lo Hot Springs.

Sylvilagus nuttallii nuttallii. Washington cottontail.—One was seen October 21, 1917, in brush along Rattlesnake Creek.—LEE R. DICE, *Museum of Zoology, University of Michigan, Ann Arbor, Mich.*

SILK BUFFALO ROBES

In the Journal for August, 1921, Mr. E. R. Warren of Colorado Springs, Colorado, asked for information in regard to a "silk buffalo" robe. Recently, while glancing through Volume 1 of Ernest Thompson Seton's "Life Histories of Northern Animals," I found the following: p. 250: "The 'Beaver robe' was a rich brown with very fine fur, of these not more than one in ten thousand was found." P. 283, quoted by Seton from C. E. Denny, *Forest and Stream*, May, 8, 1897, p. 362: "The robe was nearly always of a cow, very fine and very light. Many explanations were given by hunters for this peculiar coat, and the right one was no doubt that given by Montana Indians—that it was caused by the constant licking of many animals in the herd, to which some motherless calf belonged, it having become the pet of the band, the animals testifying their liking in that manner." Thinking this may interest other readers of the Journal, I am sending it on.—K. F. BASCOM, *Dept. of Zoology, University of Chicago, Chicago, Ill.*

RECENT LITERATURE

Grinnell, Joseph. A GEOGRAPHICAL STUDY OF THE KANGAROO RATS OF CALIFORNIA. University of California Publications in Zoology, vol. 24, no. 1, pp. 1-124, pls. 1-7, text figures 1-24. June 17, 1922.

Grinnell's "Geographical Study of the Kangaroo Rats of California" presented with a wealth of pertinent detail is not only a valuable contribution to our knowledge of an exceedingly interesting and imperfectly known group of rodents, but has an important bearing in a wider field as well. The main purpose of the work as stated by the author has been "to ascertain the degree of correlation which exists between speciation and geography and environment," and perhaps no better group of mammals, owing to its plasticity, or a better area, due to highly diversified environmental conditions, could have been chosen.

The author's conclusions are based upon a study of 2,834 specimens from California, of which 2,212 skins with skulls, representing 213 localities, are in the Museum of Vertebrate Zoology, University of California. Four hundred and nine specimens of kangaroo rats in the collection of the Biological Survey, United States Department of Agriculture, representing species and localities deemed of special importance by the author, were shipped from Washington, D. C., and material was made available by other institutions.

Thirty-three species and subspecies of kangaroo rats are recognized as ranging within the State of California, "as many forms as occur all told outside of this State and at the same time do not reach into it." These are assigned to the Heermanni, Ordii, Merriami, Agilis, Microps, and Deserti groups, the group names being those of typical included species.

Until Doctor Grinnell began his work upon the kangaroo rats, three generally accepted genera, *Dipodomys*, *Perodipus*, and *Microdipodops*, were assigned to the subfamily Dipodomysinae. The generic separation of *Dipodomys* and *Perodipus* rested upon the supposed constancy of a differential number of complete digits on the hind foot. The author, however, has made the important discovery that in parts of the distribution area of *Dipodomys heermanni* the small rudimentary first toe on the hind foot may be present or absent. The detection of positive evidence of intergradation in this character within a limited area between forms obviously not otherwise materially different is of special interest, in view of the remarkable constancy with which a fixed number of digits (4 or 5) on this foot is maintained in all of the species throughout the remainder of the wide range of the subfamily from the Valley of Mexico to southern Washington and Montana.¹ All of the species heretofore assigned to the five-toed genus *Perodipus* are therefore transferred to the genus *Dipodomys*. No reason is noted for the omission of the genus *Microdipodops*, currently regarded as a true kangaroo rat and represented in California by one species, the inclusion of which would have completed the treatment of the subfamily within the state.

¹ This condition seems somewhat analogous to that obtaining in certain squirrels, and in bats of the genera *Artibeus* and *Myotis*. The number of premolars constant in most of the included species is variable, owing to obsolescence in several, and the tooth formula therefore becomes unreliable as a generic character.

The apparent effect of climate upon the color and texture of the pelage in kangaroo rats is pointed out, closely paralleling the findings of revisers of other groups of rodents with geographic ranges embracing both the humid Pacific coast region and the arid interior. Examples of nearly parallel conditions are found in the wood rats—*Neotoma intermedia intermedia* of the western slope of the mountains, and *Neotoma intermedia desertorum* of southeastern California; and *Neotoma cinerea cinerea* typical of the Great Basin and its darker coastal counterparts *Neotoma cinerea occidentalis* and *Neotoma cinerea fusca*, and in others which may be readily cited.

Consideration of habitats, says the author, "in connection with size of ear brings out unmistakably the correlation of small pinna with open type of habitat, and in the other direction, of large pinna with a chaparral type of habitat. The same tendencies are to be observed in *Peromyscus* and *Perognathus*." While this may appear to be true in some of the California forms of these genera, it should be noted that the kangaroo rats with the largest and the smallest ears, *Dipodomys elephantinus* and *Dipodomys microps*, are assigned habitats as species wholly within chaparral, and more open types of country, respectively. The large-eared California pocket mouse, *Perognathus femoralis*, which the author may have in mind, is another chaparral-loving species with a very restricted known range. Some species of *Peromyscus* and of mammals in general inhabiting open types of country have very large ears. Admitting that certain large-eared species of kangaroo rats are associated in California with more brushy habitats than are usual in the general group, such generalizations would seem better based upon studies of more widely ranging species subdividing into geographic races and inhabiting cover of varying density.

In the discussion of distributional considerations the conclusion is reached that "as regards the species and subspecies of kangaroo rats in California, humidity is of minor importance as a barrier to extension of range as compared with unfavorable temperature and bodies or streams of water." The probable evolution of ranges is traced. Owing to the aversion of *Dipodomys* for water, continuous bodies of this element are regarded as effective barriers, but *Dipodomys deserti* and *Dipodomys merriami* occur on both sides of the lower Colorado River where shifting river channels transferring tracts of inhabited bottom land from one side to the other have doubtless given access to the opposite side. The transference of individuals, postulated by the author, would be especially likely to occur during such extensive changes in the course of the stream as took place fifteen years ago, when through the agency of man in cutting a narrow irrigation ditch, the great river was unintentionally turned into Salton Sea whence it was redirected with the greatest difficulty at the end of about a year; and the course taken by the main stream since this diversion is in places many miles west of that formerly followed.

In the formal treatment of species there are no generalized accounts of species as aggregations of subspecies, the author passing directly to a consideration of the component parts. The first species receiving attention is *Dipodomys heermanni*, and in treating its parts, instead of following a common custom among revisers of taking up first the typical subspecies, he begins with the widely ranging northern form, *Dipodomys h. californicus*, and proceeds southward, the typical form being third in the series. On reaching *Dipodomys agilis*, however, the typical

form is the first treated. The accounts include the principal synonymy, a "diagnosis," discussion of relationships, and full paragraphs under several other headings—the type locality and distribution, together with localities and numbers of specimens examined, being placed at the end. Measurements, including "ear from crown," when available, are given under each species, and in many instances the weights in grams, a valuable feature.

In regard to methods of measuring the author states that total length given "is the distance (with body and tail straightened out) from the tip of the nose to the tip of the last caudal vertebra, taken usually after skinning. If this measurement is taken in kangaroo rats before skinning, there is a chance of error because the skin sometimes slips backward some millimeters free from the actual tip of the vertebral series. Tail vertebrae is length of tail alone, from a point on upper side at base where tail can be bent at right angles to back, to tip (as just designated)." It seems to the reviewer that such a method of measuring specimens is an attempt to attain a degree of accuracy impracticable in general work. The most valuable field measurements, on the whole, are those taken by as nearly standardized methods as possible adopted by preparators in general, because these will be fairly comparable, while variations from the general standard may be misleading in application without the constant repetition of explanations. Measurements taken by different collectors, whether before or after skinning, vary with the tension exerted or with other individual peculiarities of method, and they vary, moreover, with the degree of relaxation of the body of the animal. Tables of measurements usually reveal considerable range of individual variation in total length and length of tail in animals of comparable age, and the average is obviously governed by the relative number of large or small examples chosen. These measurements must therefore usually be regarded as approximations only, which for most practical purposes should be taken before skinning, the body and tail being carefully straightened or extended to the natural limit, but not stretched.

The taxonomic treatment of a group, especially the number of forms recognized, their status as species or subspecies, and the distribution area assigned to each is likely to vary always with the varying standards set up by different workers. Perhaps no two would arrive at exactly the same conclusions. Local variants are of great interest to the close student of speciation and geographic distribution, and the current tendency is toward greater refinement in the process of "splitting," in such classes as mammals and birds at least, until the forms, if accepted, become so numerous and their ranges so restricted that the determination of new accessions of specimens is accomplished only with the greatest difficulty. The tendency to set up an excessive number of local forms is apt to be marked in faunal papers, in which the irregular, minor geographic variations presented by many widely ranging species are appraised at more than their true value. The reviser of the genus has the advantage of the wider viewpoint of the group as a whole.

In so diversified a region as California the desirability and practical utility of recognizing a considerable number of well-marked geographic races of kangaroo rats, some of which have very restricted ranges, is freely granted. But in the opinion of the reviewer the author in some of his conclusions accords undue importance to characters ascribed to certain forms, examples of some of which are cited. "*Dipodomys levipes*," originally described as a subspecies of "*Perodipus microps*,"

is elevated to full specific rank, although it "agrees with *microps* in important features of the cranium" and the "two species are similar in their rather dark type of coloration, as well as in most other external features." The differential characters mentioned are the larger size of *levipes* and details subject to considerable variation. The author is usually careful and generally accurate in his descriptions, but the statement that the mastoid bullæ in *levipes* are "fully twice the volume of those in *microps*" is inexact. This is a very variable character, as shown by the examination of paratypes of the two. The mastoid bullæ of the larger examples of *microps* closely approach or about equal those of the smaller examples of *levipes*. Probably a study of the complete range of the *levipes* type of animal across Nevada to Utah and northward to Oregon would have led the author to adopt their original status as subspecies, not very strongly marked at best.

The "Heermanni Group" is made to include four distinct species, *Dipodomys panamintinus*, *D. leucogenys*, *D. mohavensis*, and *D. stephensi*, with very limited, contiguous, or only slightly separated ranges in a region of general physiographic conformity, mainly the desert basal slopes of the mountains in southeastern California. These all agree in the possession of a salient character indicating very close relationship, the decided expansion of the maxillary arches, which at once distinguishes them from externally similar species of the genus which frequently occur in the same localities. The forms "*mohavensis*" and "*leucogenys*," described as new species, vary considerably, but specimens from the type localities are slightly paler than topotypes of *panamintinus* and present slight cranial differences, mainly size, the kind of characters we learn by analogy to regard as of not more than subspecific value. Their combined ranges half encircle that of *panamintinus*, and other geographical considerations indicate the expediency of reducing them to subspecies, or reuniting all under a single name. In cranial details *D. stephensi* presents a rather slight departure from the *panamintinus-leucogenys-mohavensis* type in that the mastoid bullæ are decidedly more inflated and there is a correlated reduction in width of the supraoccipital and interparietal, a condition not uncommon elsewhere in the genus. This form stands somewhat apart and should, perhaps for the present, be accorded specific rank, but as the characters are those usually found to be of subspecific value, intergradation may reasonably be expected.

Two subspecies, *D. nitratoides nitratoides* and *D. n. brevinasus* are assigned to very limited ranges known to be broadly confluent in the bottom of the southern end of the San Joaquin Valley, an area presenting little diversity in faunal complexion. The characters pointed out are variable and these forms are not regarded by the reviewer as satisfactorily separable. Other cases might be mentioned, but these among the more extreme examples are indicative of the general method of treatment.

While Doctor Grinnell may not be followed in all of his conclusions concerning speciation, the severest criticism being that this part of the work is over-done, he has succeeded admirably in the main purpose as announced by him at the outset; but the degree of correlation between speciation and geography and environment can be satisfactorily ascertained without the recognition of an unwieldy number of forms. His elucidation of some complicated relationships will greatly facilitate the revision of the genus *Dipodomys* as a whole.

—E. A. Goldman.

Gregory, William K. *THE ORIGIN AND EVOLUTION OF THE HUMAN DENTITION*. Baltimore: Williams & Wilkins Co., pp. i-xviii, 1-548, including plates. 1922.

The *Origin and Evolution of the Human Dentition* is primarily a review covering a wide field of research, carried over a number of years, both by the author and other authorities. It therefore constitutes an authoritative and comprehensive treatise in which the author has brought together and presented in a masterful way a vast fund of highly important and valuable information. Incidentally, many important controversial questions have been discussed. The author doubtless will not be followed by some in all his deductions and conclusions regarding these questions, yet it cannot be denied that they have been frankly and fairly argued. Doctor Gregory has presented both sides of all controversial points in his usual fair-minded manner, and has handled the facts in a way to inspire the confidence of the reader in his ability to observe clearly and to interpret intelligently. Regardless, therefore, of what may be the verdict of other authorities in accepting or rejecting some of the theories defended by its author, this book must stand as a most valuable and convenient reference work on the subjects treated therein.

The book is splendidly illustrated with 353, for the most part, accurately executed line drawings and half-tone figures. Although most of these have appeared in various earlier publications, either of the same author or those of others, their reproduction here adds immeasurably to the value of the work.

Lack of space does not admit a complete or even adequate partial review of this important work, hence little more is attempted here than to give a very general outline of the subject matter contained in it.

The book, which contains more than 500 pages, consists of five major parts which were first published in five successive numbers of the *Journal of Dental Research*, to which have been added an important preface and several corrections of errors which crept into the original publications.

Part I deals principally with the earliest stages in the development of teeth in the vertebrates and with the principal steps in evolution leading up to the early mammalian types of dentition. It includes an exhaustive review of the general theory of tooth-cusp development in the mammals, in which the author upholds in part the Cope-Osborn tritubercule theory, and accepts in general but not in its entirety the "premolar-analogy" theory as defended by Wortman and Gidley. In this connection he has introduced a hypothesis of his own, which is mentioned here only because of the very vital bearing it has on a very fundamentally important deduction postulated by the author in its assumption, namely, that the type of upper molar in which the paracone and metacone are fused, or but slightly separated, and set well inward from the buccal side of the tooth crown (such as *Centetes*, *Potamogale*, *Solenodon*, etc.) is nearest to the basic type of dentition from which have been derived all the more modern forms of tooth structure of the placentals and marsupials. This is based on an assumption denied by Gidley (1906) that the main internal cusp in the upper molars of such forms as *Dryolestes* of the Upper Jurassic is not homologous with the corresponding cusp in modern mammals, but that it represents the primitive reptilian cone, which, through the inward building of a cingulum cusp (the "protocone") finally became the paracone-metacone of modern mammals. There is not space to discuss this important question here, but it may be stated on the authority of the present re-

viewer, who has critically studied these so-called Jurassic mammals, that Gregory's theory has been based largely, at least, on a wholly erroneous conception of the true structure of the upper molars of *Dryolestes*. Happily, however, the truth or falsity of Gregory's deductions in this regard do not materially affect the broader proposition of the derivation of modern mammalian molar teeth from the ancient tritubercular-tuberculosectorial type of teeth.

Part II is primarily an introduction to the study of the evolution of the teeth in the Primates and deals at length with the origin and early development of this great order, while the taxonomic position of its earliest known representatives is discussed. The author here reaffirms his former classification of the Primates in which he placed the Eocene notharctids definitely in the "Lemuroidea" as opposed to Wortman's disposition of this group, which the latter concluded were true anthropoids, but no new evidence is added in support of this affirmation. In this part also are presented the principal steps leading from the primitive mammalian tooth structure to the primitive primate dentition.

Part III is devoted almost entirely to a study of the dental structure and other anatomical modifications of the so-called large-eyed, short-jawed primates, including the Eocene members of the Tarsioidea, and the South American monkeys, in respect to the possible origin of their living representatives. In this connection the author has made a special study of the various groups of South American monkeys with reference to their possible bearing on the problem of the origin of man.

The same general discussion is continued in Part IV, which deals principally with Old World monkeys and apes. In this section are reviewed and discussed the anthropoids of the Miocene and Pliocene and their supposed modern descendants, especially in their more immediate relation to the origin of the human race and the development of the human dentition. It is concluded from these studies that man "has been derived from the *Dryopithecus* group of the Simiidae in the late Tertiary,"

In Part V the author discusses fully the later stages in the evolution of the human teeth and considers more in detail the dental characters of extinct races of men, comparing them critically with those of the anthropoid apes. This is followed by a conspectus of the species and chief races of the Hominidae. At the end of Part V the author concludes with a final summary of the whole work in which he outlines "twenty-six stages in the ascent of man and in the evolution of the human dentition."

—J. W. Gidley.

Underwood, William Lyman. *WILD BROTHER*. Boston; The Atlantic Monthly Press. 12mo, pp. i-xi, 1-140, 39 plates. 1921.

On January 23, 1903, in the woods of northern Maine a cook from a logging camp shot a black bear in a den under a large dead pine tree, and by this act made orphan a naked, week-old cub. This little cub becomes "Bruno," the Wild Brother, of Doctor Underwood's story. We read how he is adopted by a kind-hearted woman and nursed at her breast as foster brother to her little girl; and how he becomes a burden to his foster parents and is taken to the home of Professor Underwood at Belmont. And then his behavior and pranks at Belmont are revealed to us in a most interesting manner. For example, we read: "..... Down in the garden one day I found a large fat toad, and when Bruno was at lunch

I placed the warty creature on the ground beside the saucer from which the cub was taking his food. Being quite hungry, at first he paid no attention to the intruder; but presently, as the saucer became empty, he caught sight of his curious visitor. With a jerk he raised his head, and for a moment, without moving a muscle, gazed in astonishment and with some misgiving at the strange monstrosity in front of him. His natural curiosity, however, soon overcame his doubtful frame of mind; he was a born investigator and this thing must be looked into. Very cautiously he reached forward his paw and ever so gently he touched the curious thing on the back.

The toad did as toads usually do when tickled from behind. It hopped, and with such force that it went quite over the saucer. Simultaneously the bear stood erect. He had a puzzled look of amazement and dismay on his hairy visage; he appeared to be utterly overcome with astonishment. It didn't seem reasonable that an insignificant misshapen creature like that could, with no apparent effort, cover so much ground in one leap. Bruno's paws hung inertly in front of him and his tongue lolled stupidly from his mouth. His breath came in short explosive gasps.

Suddenly the toad hopped again, and with a 'Whoof, whoof, whoof,' away ran the bear round the corner and out of sight. No more toads for him; one was enough for a lifetime!"

The book ranks among the best nature stories published in recent years. It is trustworthy, unexaggerated, and well written. The press work is excellent, the paper of good quality, typography clear, illustrations numerous and attractive, and the binding neat and durable. It is a book that might well be read by anyone interested in nature, mammalian behavior, or good literature.

—Hartley H. T. Jackson.

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